APRIL 1951

No. 173

ASTM Bulletin

NEWS—Committee Week Notes; Annual Meeting and Marburg Lecture; Standards Actions; Nomination for Officers.

PAPERS—Weather Aging of Plastics; Reflectance Readings of Traffic Paints; Vibrations in Railroad Freight Cars; Izod Impact Test; Method of Test for Specific Heat; Properties of Old-Growth Douglas Fir; Strength of Glued Laminated Wood Construction; Stiffness of Elastomers.

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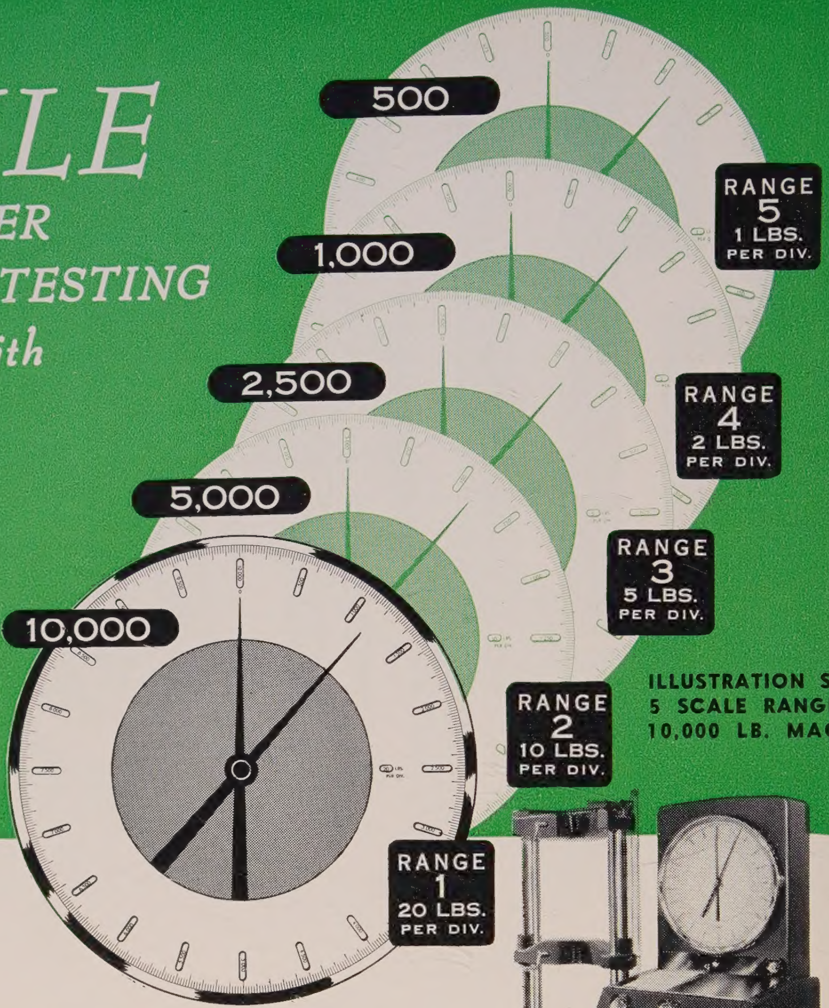

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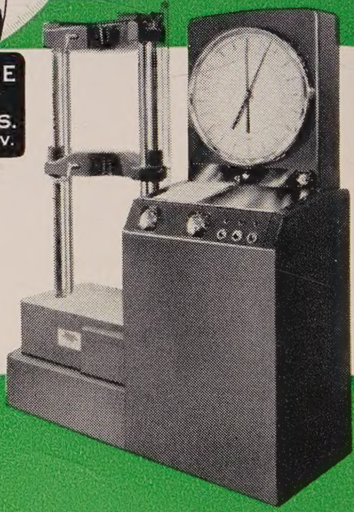

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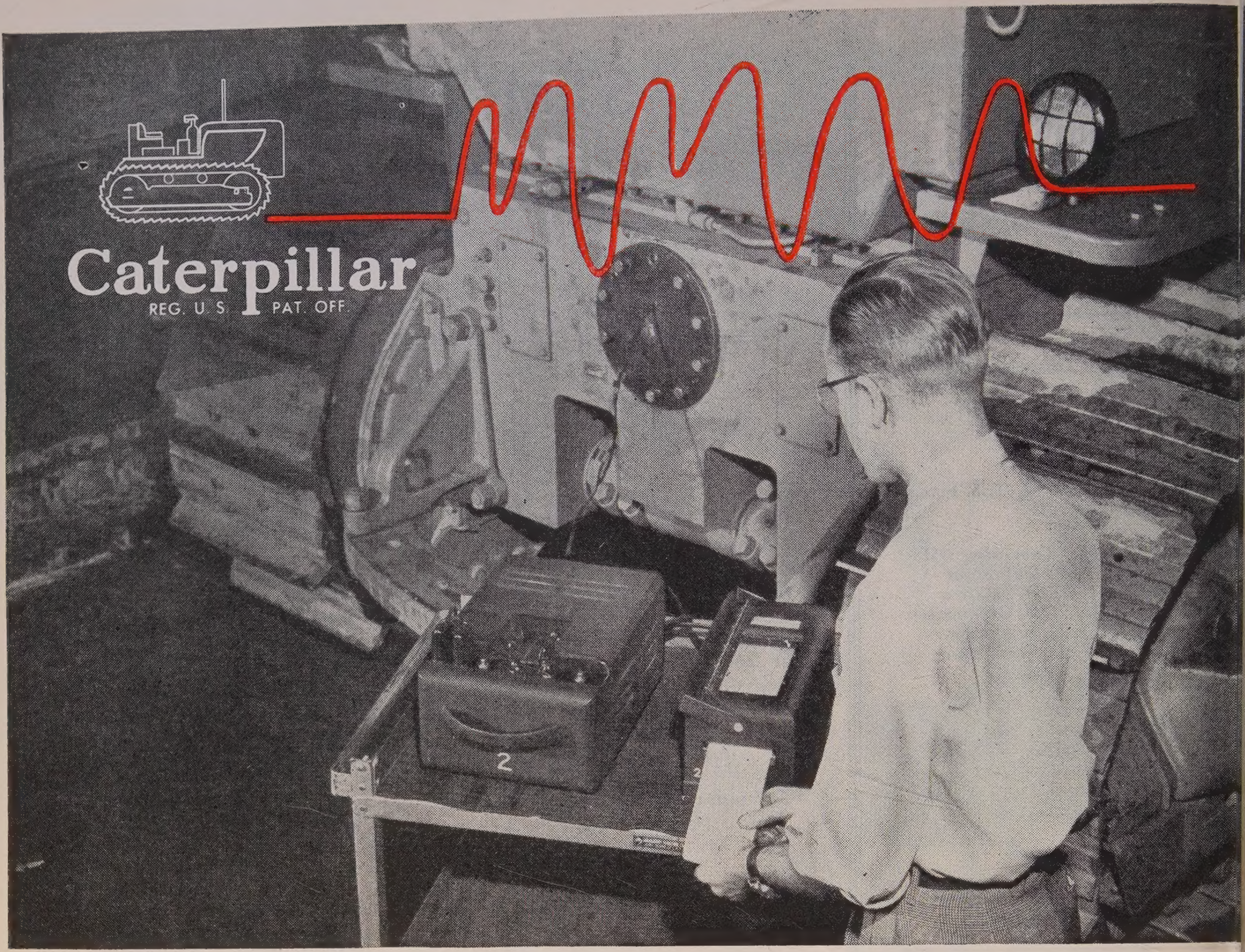

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315 | R. E. Hess, Editor | R. J. Painter, Associate Editor | CABLE ADDRESS—TESTING, Philadelphia

Number 173 — APRIL, 1951

Much Activity During ASTM Committee Week

835 Technical Men Attend ASTM Committee Week in Cincinnati—Many New Standards Completed; New Research on Materials Undertaken

During ASTM Committee Week in Cincinnati, March 5 to 9, inclusive, much new research work was discussed at the some 200 meetings of the Society's technical committees, and many new specifications and tests for materials and numerous revisions were completed.

This year the registration total was 835, compared to 990 in 1950, but this figure varies from year to year depending upon the number of committees which meet. This year such large groups as D-1 on Paint, D-2 on Petroleum, A-1 on Steel and others, met earlier in other cities.

A large number of meetings are concentrated during this week so that the committee members, leading technical men concerned with specifications and tests, can attend the various meetings with considerable saving of time and expense.

Most of the new and revised standards completed at the meeting are subject to letter ballot in the committees before they are referred to the parent Society for action. In general the new specifications will be considered finally at the ASTM Annual Meeting in Atlantic City during the week of June 18, although some may be approved prior to that meeting through the Administrative Committee on Standards.

A list of the major committees which met in Cincinnati follows. Most of these had numerous subcommittee and section meetings. Technical committees which convened recently in other cities are also noted.

Committee A-3 on Cast Iron:

Committee A-3 is developing specifications for nodular cast iron, cast iron for elevated temperature, and chilled or white cast iron as well as a recommended practice for Brinell hardness testing of cast iron.

Several grades of nodular cast iron have been mentioned in discussions that are expected to culminate in ASTM specifications. These products possess high strength and their toughness is developed by annealing.

Novel methods for testing chilled and white iron castings used for rolls, steam-heated grinding rolls, crushers, and similar abrasion-resisting castings have been discussed in subcommittee meetings. Specifications covering this material are in the process of preparation.

Specifications governing the use of cast iron for pressure vessel service up to 650 F. have been approved and forwarded to The American Society of Mechanical Engineers for processing into the Boiler Code. The ASME is revising the section of the Code dealing with cast iron and expects to complete its work in 1951, in the course of which the ASTM specification will be embodied in the code.

A recommended practice for Brinell hardness testing of cast iron has been drafted. Upon completion, this work will be added to practices now established dealing with torsion testing, compression testing, and impact testing.

Some work on the classification of fractures of cast iron has been initiated and it is proposed further to explore impact testing, corrosion testing, and hydrostatic pressure testing.

Committee A-5 on Corrosion of Iron and Steel:

Although there was no main meeting of Committee A-5 in Cincinnati during ASTM Committee Week there were meetings of two active subcommittees. Subcommittee XI on Sheet Specifications has under consideration a specification for 1.25-oz roofing sheets (galvanized). It is hoped that this specification may be ready for submission to the Society at the Annual Meeting in June. The subcommittee is also considering revisions of Specifications for Zinc Coated (galvanized) Wire or Steel Sheets (A 93–48 T) to include a bend test for sheets ranging from No. 11 to No. 15 gage.

Subcommittee XIII on Hardware Specifications is considering revision of A 123–47 (galvanized structural steel shapes, etc.) to cover materials having lower weights of coating than now specified.

Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys:

The primary discussion in the meeting of Committee A-10, was the current world situation in regard to availability of columbium and the necessity for substituting columbium-tantalum in all specifications now embodying the present columbium alloy. This suggestion was discussed at great length and it was agreed that this change should be made in the very near future, possibly in a form similar to the ASTM emergency alternate specifications of the last war.

Also being developed in the committee are several specifications:

(a) A specification which would provide two alternate types of test specimens for determining the tensile strength of plates.

Are you interested in?: ASTM Committee Week—p. 5; Spring Meeting—p. 8; Annual Meeting—p. 12; Marburg Lecture—p. 13; Actions on Standards—p. 14; Nominations for Officers—p. 20; District Activities—p. 22; Outdoor Weather Aging of Plastics—p. 31; Traffic Paints—p. 44; Vibration in Railroad Freight Cars—p. 46; Izod Impact Test—p. 48; Properties of Old-Growth Douglas Fir—p. 52; Nomograms for Calculating Stiffness of Elastomers—p. 59.

(*b*) A specification for stainless steel strand wire.

(*c*) A specification for centrifugally cast high alloy corrosion-resisting tubing.

A draft of this latter specification is under consideration in Subcommittee X.

Revision of Specifications for Seamless and Welded Austenitic Stainless Steel Pipe (A 312–48 T) is under consideration for several reasons: the possibility of adding grades 309 and 310, the suggestion that a new pipe size (schedule 5S) be added to the appendix, consideration of the revision of the heat-treatment section, and a change in the phosphorus content.

Committee B-7 on Light Metals and Alloys, Cast and Wrought:

As a result of an approach from the ASME Boiler Code Committee, consideration is being given in Committee B-7 to revising the Tentative Specification for Aluminum and Aluminum Alloy Sheet and Plate for Use in Pressure Vessels (B 178–50 T) to include minimum yield strengths. This request also included a recommendation that the committee develop a specification for tube and pipe for similar uses.

Recommended changes in a number of specifications were submitted to letter ballot action. Specification B 80–49 T (magnesium-base alloy sand castings), B 90–49 T (magnesium-base alloy sheet), B 107–49 T (magnesium-base alloy rods, bars, and shapes), and B 199–49 T (magnesium-base alloy permanent mold castings) are being revised to include temper designations. Specification B 107 is being further revised to include hollow shapes and the addition of alloy ZK60. This alloy is also to be added to Specification B 217 and alloy AZ80A is to be deleted. A new alloy AZ91C is to be added to Specification B 93–49 T (magnesium-base alloys in ingot form). It is being recommended in Specification B 209–50 T (aluminum-alloy sheet and plate) that samples for the bend test specifications be taken from each 2000 lb of sheet and 4000 lb of plate rather than from each 1000 and 2000 lb, respectively.

After a considerable amount of work over the past several years, the committee has now prepared (subject to letter ballot) for submission to the Society in June, a "Tentative Recommended Practice for Codification of Light Metals and Alloys, Cast and Wrought." In regard to the codification of light metals and alloys, a representative from the Canadian Standards Association stated that his group will study this matter so that the standards in both Canada and the United States might be based on the same codification systems.

Future work of this committee includes the consideration of a specification for plaster-mold investment castings and a comprehensive aluminum and magnesium atmospheric exposure test program.

Committee B-8 on Electrodeposited Metallic Coatings:

One of the primary activities of this committee during the past several years has been the development of numerous specifications and recommended practices for plating various materials. Some of the materials covered are zinc and cadmium on steel, nickel and chromium on steel, on copper base alloys and on zinc base alloys, lead on steel, etc. This activity is continuing and the committee will present to the Society in June recommended practices for preparation and plating on: (1) Zinc-base die castings; (2) Aluminum; (3) Stainless steel.

Subcommittee IV, which developed these recommended practices, is also making progress on specifications for plating on copper and copper alloys and on plastics. They are also surveying the need for recommended practices for plating lead and lead alloys and malleable and cast iron.

Specifications B 201–49 T for Chromate Finishes on Electrodeposited Zinc, Hot-Dipper Galvanized, and Zinc Die-Cast Surfaces, and A 219–45 T on Local Thickness of Electrodeposited Coatings are to be continued as tentative in view of the work going on in various subcommittees.

One of the projects under consideration in the committee is the use of metric system equivalents in addition to English units in all specifications under its jurisdiction.

Subcommittee V on Supplementary Treatments is currently preparing zinc-plated test panels which will be give[n] treatments and exposed to the atmos[phere]. The group is also investigating th[e] use of various chromate treatments o[n] cadmium-plated specimens.

List of Recent Committee Meetings

(Those meeting elsewhere than Cincinnati are indicated)

A-1 on Steel (Cleveland)
A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-7 on Malleable-Iron Castings
A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
B-1 on Wires for Electrical Conductors (New York)
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-4 on Electrical Heating, Resistance, and Related Alloys (New York)
B-5 on Copper and Copper Alloys, Cast and Wrought (Philadelphia)
B-7 on Light Metals and Alloys, Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement
C-3 on Chemical-Resistant Mortars
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-12 on Mortars for Unit Masonry
C-15 on Manufactured Masonry Units
C-16 on Thermal Insulating Materials
C-17 on Asbestos-Cement Products
C-22 on Porcelain Enamel
D-1 on Paint, Varnish, Lacquer, and Related Materials (Washington, D. C.)
D-2 on Petroleum Products and Lubricants (Washington, D. C.)
D-4 on Road and Paving Materials
D-5 on Coal and Coke
D-6 on Paper and Paper Products (New York)
D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-Like Materials
D-16 on Industrial Aromatic Hydrocarbons
D-17 on Naval Stores
D-18 on Soils for Engineering Purposes
D-19 on Industrial Water
E-1 on Methods of Testing
E-4 on Metallography
E-5 on Fire Tests of Materials and Construction
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-12 on Appearance (Washington, D. C.)

C-1, C-9 on Cement, Concrete and Concret[e] Aggregates

After many years of at[tempting] to formulate standard freezin[g] and thawing tests on concrete, much hop[e] was expressed during the meetings of Committee C-1 on Cement and C-9 on Concrete and Concrete Aggregates that suc[h] could be accomplished. These two committees are jointly convinced that ther[e] should be an ASTM standard and one is t[o] be prepared during the next few month[s]. The responsibility for this developme[nt] was placed in Committee C-9, where a ne[w] subcommittee was authorized.

Another interesting development, re[sulting] from much study and considera[tion], is a decision of Committee C-9 t[o] formulate a standard chemical test f[or] alkali reactivity of aggregates, using as [a] basis the "quick chemical test" of th[e] Bureau of Reclamation and the metho[d] used by the Corps of Engineers. Anoth[er] proposed method in this field is the mort[ar] bar test procedure (ASTM designation [C] 226 T) for determining the chemical rea[c]tivity between cement and aggregate com[binations]. These two methods will b[e] distributed for comment and subseque[nt] letter ballot. A third new method, deali[ng] with concrete aggregates, will cover petr[o]graphic examination of aggregates; this [is] to be published as information. Two fu[r]ther test methods under development, pe[r]taining to chemical reactivity, will invol[ve] potential volume change and abnorm[al] expansion of cement-aggregate combin[a]tions.

After much study and consideration, [a] proposed specification for paper molds [for] test specimens has been agreed upon and [is] to be distributed for comment.

A complete revision of the Specificati[on] for Concrete Aggregates (C 33) is to [be] distributed as information preparatory [to] letter ballot. The new specification w[ill] be more in the nature of a framewo[rk] whereby specific limits may be inserted [for] certain applications. A second draft of t[he] complete revision of the Specification [for] Lightweight Aggregates for Concrete [(C] 130) has been agreed upon. Agreeme[nt] has been reached on most of the poi[nts] involved in making the ASTM specifi[ca]tions and test methods covering additi[ons] for cement and admixtures for concr[ete] similar. This includes the ASTM ten[ta]tives C 226 T, C 233 T, and C 260 T.

The new subcommittee studying res[ist]ance to abrasion has reviewed exist[ing] methods, which they have classified i[nto] two types, namely cutting and rubbi[ng]. A round-robin testing program will [be] inaugurated. The new subcommittee [on] setting time of concrete is studying [the] rate of hardening.

Committee C-3 on Chemical-Resistant Mortars:

Particularly interesting at the meeting of Committee C-3, during Spring Committee Week in Cincinnati, were the progress reports on current investigations in the subcommittees, some being outlined below. Definitions of types of silicate mortars have been rewritten, and the question of proportion of aggregate to binder was discussed and is now subject to revision. A proposed specification for air-setting silicate mortars has been drafted.

In regard to resin cements it was decided to delete both the flexure and permeability tests as being unnecessary requirements in a specification. Revisions in the tests on sulfur mortars were considered and minor changes are to be incorporated in the proposed specification.

Drafts of test methods for chemical resistance of hydraulic mortars were reviewed and are to be submitted to letter ballot for approval. A summary of research on working and setting time with the Brabender and Brookfield type HBF viscosimeters was presented. A promising method for determining the bond between chemical-resistant mortars and acidproof brick had been developed. This involves the uses of a cross brick specimen loaded to failure using a special test head. Even with the number and variation of tests being limited, quite consistent results were obtained.

Committee C-7 on Lime:

Research work in Committee C-7 on Lime has been concentrated on the development of a laboratory slaker for slaking lime which is well along, with a final report expected at the June Meeting in Atlantic City.

A special task group has been appointed to study the Standard Specification for Sand for Use in Plaster (C 35), which is under the joint jurisdiction of Committee C-7 and Committee C-12 on Masonry Mortars. This review is to develop any necessary changes due to the increased uses of such lightweight aggregates as perlite and vermiculite. Initially it is expected that Committee C-12 on Mortars for Unit Masonry will give this matter first consideration.

The committee went on record approving the new tentative specification for masonry mortar proposed by Committee C-12, with, however, certain comments, which will be presented to Committee C-12 for further consideration. A progress report was presented covering round-robin test on settling rates on lime and on iron determination, with more work being needed before a final report is submitted.

C-8 on Refractories

The 1951 edition of the Manual of ASTM Standards on Refractories, to be published in the late spring, will contain useful additions to the group of industrial surveys which it now contains. The new surveys will include the lead industry and a survey of refractories used in incinerators. Revisions of the ten existing surveys are also being completed, including the one on malleable iron. These matters were covered in C-8 meeting.

The Research Subcommittee has completed its study of three-point loading, the results of which will be considered by the Subcommittee on Tests. Much activity was reported in the several sections under the Subcommittee on Tests including an investigation of sonic testing, effect of thickness of specimens in the panel spalling test, a proposed revision of the methods of chemical analysis (C 18) to include dolomite in the magnesite section, an indication that there is no effect from increasing loading rates within a certain range in the modulus of rupture tests for refractory insulation, and a survey of available methods that has been made on bulk density and porosity of calcined materials. It has been proposed to separate the test methods contained in the present Specification for Castable Refractories (C 13) for adoption as separate methods. The Specification Subcommittee recommended the advancement to standard of the existing tentative revisions to C 63, C 64, C 106, and C 213.

A progress report covered studies on many special refractories including mullite products and refractory dolomite, such as calcined and dead-burned dolomite and zircon. An important step was approved by Committee C-8 in authorizing an extensive research program on special refractories, necessitating raising funds over a period of five years. A special section has been authorized to conduct a solicitation of funds from industry. It is expected the research program will include the study of such important items as reheat, high-temperature load tests, and slag tests.

The Fall meeting of Committee C-8 will be held at Bedford Springs, Pa., at the time of the meeting of the Refractories Division of The American Ceramic Society.

C-12 on Masonry, Mortars and Units

An important accomplishment, as reported at the meeting of ASTM Committee C-12 on Mortars for Unit Masonry, is the acceptance of a new specification for mortars for unit masonry, which will now go to letter ballot. This proposed specification is the result of ten years' study and effort.

These specifications cover mortars of four types for use in the construction of unit masonry structures. They include two alternate specifications as follows:

I. *Property specification* in which the acceptability of the mortar is based upon the properties of the ingredients (materials) and the properties (water retention and compressive strength) of samples of the mortar mixed and tested in the laboratory.

II. *Proportion specification* in which the acceptability of the mortar is based upon the properties of the ingredients (materials) and the proportions of these ingredients.

It is expected the existing Specification for Mortar for Reinforced Brick Masonry (C 161 T) will be discontinued when the new tentative specification is advanced to standard.

Committee C-15 on Masonry Units recommended the adoption as standard of all existing tentative revisions to the Specification for Building Brick (C 62 and C 73). Further research work is to be stimulated on the important subject of weathering qualities of clay units. The final draft of the proposed specification for chemical resistant units has been completed and will be submitted to Committee C-15.

C-16 on Thermal Insulating Material

The effect of moisture on thermal conductivity has long been of concern to the users and producers of thermal insulating materials. ASTM Committee C-16 outlined an extensive research project to study this problem.

Several new test methods were recommended for letter ballot approval, including one for determining density of preformed block insulation, density of preformed pipe insulation, and blanket type pipe insulation. In addition, a new specification for molded type mineral wool pipe insulation for elevated temperature and a tentative definition of the term "structural insulation board" were recommended.

Other proposed standards being developed include a sampling procedure for block and pipe insulation, specification for diatomaceous earth insulation, a linear expansion test method on insulating board using Forest Products Laboratory apparatus, and a method of test for determining adhesion of dried thermal insulating cement. Cooperative tests to evaluate a new method for measuring plasticity of insulating cement at any water-cement ratio, and round-robin tests to establish the maximum rise in temperature limits in measuring specific heat are under way.

It was announced that three proposed new specifications had received a satisfactory vote and will be presented to the Society for approval. These specifications cover mineral wool felt insulation, mineral wool industrial batt insulation, and mineral wool blanket insulation (metal mesh cover).

A statement on combustibility as well as a test method, is being developed, for blanket insulation.

The committee sponsored the technical session of the ASTM Spring Meeting consisting of a Symposium on Thermal Insulating Materials. Five interesting papers were presented, covering such subjects as specific heat, surface emittance, water vapor migration, and the use of the guarded hot plate apparatus for thermal conductivity determinations.

Committee C-16 selected Skytop, Pa., as the place for its 1951 Fall Meeting, which will be held in October.

Committee C-17 on Asbestos-Cement Products:

Statements on the significance of tests

(*Continued on page 9*)

ASTM Spring Meeting Features Symposium on Thermal Insulating Materials

An indication of the widespread interest in thermal insulating materials and methods of evaluating their properties was evident from the excellent attendance at the 1951 Spring Meeting of the American Society for Testing Materials in Cincinnati which featured a five-paper symposium. This was sponsored by ASTM Technical Committee C-16 on Thermal Insulating Materials, Ray Thomas, Staff Engineer, Union Carbide and Carbon Corp., past chairman of the committee, being responsible for developing the program. C. B. Bradley, leading authority in this field and a long-time member of the committee, representing Johns-Manville Corp., presided at the session which was held on March 7, in Cincinnati.

The fact that two papers in the symposium dealt with hot plate method of determining thermal conductivity bespeaks the interest in this particular equipment and its use for evaluating this important property of insulation.

The Symposium on Thermal Insulating Materials consisted of the following papers:

- Basic Concepts of Water Vapor Migration and Their Application to Frame Walls—F. A. Joy, Pennsylvania State College.
- Appropriate Methods for Measurement of Surface Emittance—L. P. Herrington, John B. Pierce Foundation.
- The Measurement and Significance of Specific Heat of Thermal Insulating Materials—Norman H. Spear, John B. Pierce Foundation.
- A Comparison of Thermal Conductivity Determination Made on 18 Different Guarded Hot-Plate Apparatus—H. E. Robinson, National Bureau of Standards.
- Experiments with a Guarded Hot Plate Thermal Conductivity Set—Charles F. Gilbo, Armstrong Cork Co.

Notes on the symposium papers follow:

Mr. Joy pointed out that excessive moisture in the walls of frame dwellings is not a new condition but its prevalence increases as modern homes are built smaller and tighter. The source is usually within the house itself, a typical family producing around 700 lb of water vapor per month.

Aspects of the behavior of water vapor are well understood by engineers, but we are puzzled to explain some moisture phenomena, and while the relation that vapor resistance (the reciprocal of permeance) is proportional to specimen thickness is doubted by some, all data taken by the author reasonably confirm it.

The propriety of adding together the vapor resistances of its parts to get the resistance of a combination has sometimes been questioned but this is manifestly correct in theory, and all the author's tests confirm it. One such test —apparently contradictory, but actually confirmatory—is cited wherein a composite panel passed four times as much vapor in one direction as in the other with no change of the exposure conditions.

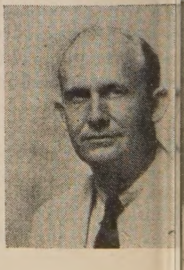
One more misconception of vapor transfer relates to the mechanism of movement in air-filled spaces. Convection of air, rather than diffusion of vapor, is the important factor. This conclusion finds important application in the air spaces of walls especially regarding leakage through small holes and cracks in barriers.

Vapor control measures include: (1) placing a vapor barrier on the warm side of the wall; (2) ventilating the house; and (3) ventilating the wall itself. The first measure has been endorsed by all authorities, but the effectiveness of certain barrier types can be destroyed by installation that is only a little short of perfect. This raises a question if such barriers are really practical. The second measure is obvious and indeed must accompany the first. The third is not widely accepted but may be the logical one in certain cases. A fourth measure, choice of a "breathing type" or high permeance sheathing paper, has been generally recommended, as a companion to a vapor barrier, but our experience does not indicate the importance o[f] high or low permeance when a barrier i[s] installed, Mr. Joy stated.

Mr. Herrington, in his paper (presente[d] by his associate, Mr. G. M. Rapp), state[d] that there is much current interest i[n] the measurement of infrared heat emis[-]sion and absorption of structural ma[-]terials. He reviewed the terminolog[y] of radiation exchange from the stand[-]point of simplicity and usefulness in [a] standardized test suitable for use with structural materials as nonincandescen[t] temperature radiators. Finally he de[-]scribed an apparatus construction fo[r] surface emittance measurement in th[e] 0 to 300 F. range.

Primary problems in the practica[l] field were discussed by Mr. Spear in hi[s] paper on Specific Heat, in terms of [a] number of illustrative examples. Thes[e] include an analysis of the effect of speci[-]fic heat on the performance of buildin[g] structures subject to different diurna[l] and seasonal temperature cycles, a con[-]sideration of pipe insulation practic[e] and a review of recent work in enginee[r]ing properties of protective clothing.

Mr. Robinson detailed a program [o]f comparative thermal conductivity tes[ts] made on corkboard at a mean tempera[-]ture from 20 to 120 F. with 19 differen[t] guarded hot plates conforming to AST[M] Methods C 177 – 45 in 16 differen[t] laboratories. Examples of results [of] good and poor agreement were presente[d] and discussed, and diagrams were give[n] showing the frequency distribution [of] average per cent temperatures for ea[ch] apparatus from results obtained on [a] reference plate.



Speakers at the Symposium on Thermal Insulating Materials from l. to r.: N. H. Spear, Research Physicist, John B. Pierce Foundation; Charles F. Gilbo, Armstrong Cork Co.; H. E. Robinson, National Bureau of Standards; F. A. Joy, Professor of Engineering Research, Pennsylvania State College; G. M. Rapp, Assistant Executive Director, John B. Pierce Foundation. Mr. Rapp presented the paper by Mr. Herrington (in insert) Director of Research, John B. Pierce Foundation.

The experiments covered by Mr. Gilbo ow that hot plates, as presently conucted, probably do not possess a ficiently accurate temperature con-l on the guard heater and that ex-mely small amounts of unbalance affect the thermal conductivity results more than had previously been supposed. It is also demonstrated that the ambient temperature, when allowed to rise above the hot-plate temperature, markedly influences the results.

ommittee Week (*continued from page 7*)

d definitions pertaining to the four ten-ives now published under ASTM desig-tion have been completed, it was an-unced at the meeting of Committee C-17 Asbestos-Cement Products during the TM Committee Week. These state-nts and definitions interpret more arly such terms as dimensions, flexural ength, deflection, and water absorption rtaining to asbestos-cement flat and rrugated sheets (C 220 T and C 221 T), ofing shingles (C 222 T), and siding ingles and clapboards (C 223 T). Fur-er revisions contemplated in the speci-ations include a revision of the minimum lue of breaking loads and deflection, the dition of ¼-inch thickness board and ising the maximum permissible water sorption to 25 per cent in the tentative ecification for flat sheets.

ommittee C-22 on Porcelain Enamel:

Committee C-22 approved recommen-tions of subcommittees that five pro-sed tentative test methods be submitted letter ballot of the committee and, if proved, be presented at the Annual eeting of the Society. The suggested ntatives include:

(1) Glossary of Enamel Terms; (2) Tenta-ve Test Method for Sieve Analysis of Wet illed and Dry Milled Porcelain Enamels;) Tentative Test Method for Resistance of orcelain Enameled Utensils to Boiling Acid;) Tentative Test Method for Acid Resist-ce of Porcelain Enamels (at room Tem-rature); and (5) Tentative Standard Test ethod for Impact Resistance of Porcelain nameled Utensils.

Reports were received on the progress the several investigations under way by e various subcommittees. Among these as a report with bibliography on methods of testing the adherence of porcelain enamels to metal, the resistance of porcelain enamels to thermal shock, and properties of base metals influencing porcelain enamel.

Proposed test methods for the determination of reflectance, and resistance to abrasion and warping have reached a stage where final reports may be anticipated in the very near future.

Many of the projects of the committee are long-range research projects which will require considerable investigation before final reports can be expected. This type of project includes such investigations as the effect of water analysis on porcelain enamel slips, and the correlation of existing literature on thermal shock testing.

The next meeting of the committee will be held on September 27 and 28 at Milwaukee, Wis.

Committee D-1 on Paint Materials, *Washington, D.C.*

The Spring meeting of Committee D-1 was featured by a panel discussion on "So You Want To Measure Gloss." Mr. Harry Hammond of the National Bureau of Standards served as Moderator.

The Panel Discussers were:

Mr. William Kiernan—Classification of Painted Surface According to Gloss; the 60° Technique.
Mr. Mark Morse—Solution to the High-Gloss Problem: Haze.
Mr. Sam Huey—Solution to the Low-Gloss Problem: Sheen.

The interest in this subject was evidenced by the numerous questions and active oral discussions from those who attended the meeting.

The D-1 meeting extended over a period of three days, February 26 to 28. There was an attendance of over 250 members and guests, and a total of 80 meetings of subcommittees and sections were held.

It was announced that a new subcommittee had been established on Flash point under the chairmanship of Mr. A. L. Brown of the Associated Factory Mutual Fire Insurance Co. The assignment given this subcommittee was to study and develop flash point methods for a wide variety of materials. Immediate work is to be undertaken on the Tag open cup method. Two different test procedures are being studied using several samples of materials used in paint manufacture.

The Subcommittees on Methods of Chemical Analysis reported completion of revised procedures for the analysis of zinc pigments and also for the analysis of white pigments. It recommended the adoption as Standard of five Tentatives covering analysis of Dry Cuprous Oxide and Copper Pigments (D 283–48 T), Acetone Extract in Black Pigments (D 305–48 T), Analysis of Zinc Yellow Pigment (D 444–48 T), Analysis of Diatomaceous Silica Pigment (D 719–47 T), and Red Pigments (D 970–48 T). New projects under study are methods for analysis of titanium pigments and also the effect of surface treating agents on pigments.

The Subcommittee on Optical Properties of Paints submitted for publication as information a proposed method of test for 85-deg Sheen and 20-deg Specular Gloss. A paper prepared by Mr. M. H. Switzer on "A Method of Test for Hiding Power of Paints" was submitted for publication in the ASTM Bulletin. The paper contains complete details of a proposed revised method and is to be published in order to obtain comments and suggestions which will be used by the subcommittee in completing this test procedure. Work is continuing on methods for determining small color differences and former work on infrared reflectance is being reactivated. The Tentative Method of Test for 60-deg. Specular Gloss of Paint Finishes (D 523) was recommended for adoption as Standard.

Action was taken to revise the specifications for distilled wood turpentine as regards the specifications for gravity limits in order to bring them into agreement with the Federal specification. Test procedures for evaporation residue and acidity are to be added to the methods of sampling and testing turpentine (D 233).

The Subcommittee on Drying Oils reported completion of a new set of methods of testing these oils which will replace Standard D 555.

The revised methods will include new procedures for determining diene number and a set to touch test. Investigative work is being continued on determination of foots, total iodine number, and conjugation. Study of the oil color method is being made in cooperation with the American Oil Chemists Society.

There are eleven active projects being studied by the Subcommittee on Physical Properties. Those nearing completion cover oil absorption of pigments, consist-

C. B. Bradley, Johns-Manville Corp., left, long-time member of Committee C-16, presided at the session, and Ray Thomas, Union Carbide and Carbon Corp., past-chairman and secretary of the committee, had arranged the symposium, as program chairman.

ency of pastes, adhesion, and permeability of paint films. A new method of test for measurement of dry film thickness of non-magnetic coating has been completed and will be issued shortly as Tentative.

A new method of test for viscosity of paints, varnishes, and lacquers by the Ford Viscosity Cup has been completed in cooperation with the Federation of Paint and Varnish Production Clubs.

Another Subcommittee submitted new specifications covering methyl isobutyl-ketone and methanol. Also a method for determination of the purity of acetone and methylethylketone. This Subcommittee is also reviewing the Standard Methods of Testing Lacquer Solvents and Diluents (D-268) and plans to make an extensive review and rearrangement of the various test procedures now included. A number of them will very likely be published separately under their own ASTM designation.

The Subcommittee on Traffic Paints completed a new method of test for determining roundness of glass spheres used in such paints. It has under study a test for crushing resistance of glass spheres. Other projects under study include tests for dirt retention time of glass beads, accelerated suspension test, and wetting characteristics of glass beads; also an accelerated test for durability of traffic paint films using the Taber abraser is being investigated.

New definitions for the terms water paint, emulsion paint, ester gum, and penta gum have been completed. Proposed definitions of some 30 terms relating to paint pigments are under study.

The Subcommittee on Varnishes reported a test program on weathering of varnishes being made by seven cooperating laboratories on six different varnishes. Results are expected to be available in June. The wearability of floor varnishes is being studied by the Taber abraser.

The Gardner viscosity bubble tube method is to be studied as regards the effect of surface tension on this test. Results of a cooperative study on a test for nonvolatile matter using a thermal hot plate has proved very satisfactory. A second round-robin is planned to study a modified method resulting from this earlier work.

Committee D-4 on Road and Paving Materials:

Reports of Committee D-4 and 16 of its subcommittees on Road and Paving Materials indicated progress on many projects under way.

A new proposed method of test for residue of specified penetration by vacuum distillation has been approved by the Committee, and it will be offered to the Society at the June meeting for approval as an ASTM tentative. Two subcommittees will cooperate in developing a new method for compressive strength of bituminous mixtures containing liquid asphaltic binders. This method will include procedures for the preparation and curing of specimens.

The triaxial compression and Marshall test methods have had widespread use in recent years, and in recognition of this, a subcommittee is planning to develop an ASTM standard for measuring such types of strength tests. This will also involve the standardization of methods for forming and compacting specimens.

A revision of the Standard Method of Test for Distillation of Tar Products Suitable for Road Treatment (D 20) has been prepared and will be published as information in order that cooperative tests may be made to substantiate the proposed changes.

Further sources of cooperative tests are planned in a study to reconcile the differences between the two existing ASTM methods for determining softening point (ring-and-ball method) D 36 and E 28 T. It was also reported that round-robin tests are being conducted with cutback asphalts for the development of a method for evaluating the curing properties.

Committee D-5 on Coal and Coke:

Committee D-5 and three of its subcommittees sponsored a very well attended joint session with the Prime Mover's Committee, Power Station Chemistry Subcommittee, of the Edison Electric Institute, at which Subcommittee XIII on Coal Sampling considered a detailed Test Scheme which the EEI group proposes to apply to one coal, using one make of automatic sampler. The scheme is designed to eliminate the question of machine bias in sampling and to provide reliable information on variability (based on Analysis of Variance) not only in the automatically collected increments, but in hand increments of several sizes collected simultaneously by partitioning the stream on a stopped belt. The ultimate aim is to promote standards which will permit least cumbersome automatic sampling for large users of crushed or fine coal.

Subcommittee XV on Plasticity and Swelling of Coal considered the results of a number of independent Gieseler plastometer tests run on samples of silicones of two different viscosities in the range common to this test. Further work toward the elimination of unwanted variables was suggested. A proposed revision of the Standard Method of Test for Free Swelling Index of Coal (D 720–46) which would permit the measurement of coke button size to obtain the index number where the button shape does not conform to any standard profile of the present Method D 720 will be circulated for detailed consideration.

Subcommittee XXI on Methods of Analyses considered further its revision of the methods for the ultimate analysis of coal and coke. No official action was taken but suggestions for additional revisions were studied and will be incorporated in a circular for the committee's further consideration.

A first draft of a procedure for the determination of mineral CO_2 was submitted which will be circulated to the committee for its consideration.

Actions by the main committee included recommendation for adoption as standa[rd] of the Tentative Test for Grindability [of] Coal by the Hardgrove-Machine Meth[od] (D 409–37 T), and that the present "alt[er]nate" Ball-Mill Method (D 408) be wi[th]drawn.

Other items of interest in the main co[m]mittee meeting included an interest[ing] discussion by Chairman W. A. Selvig [of] his continuing work with the ECA gro[up] working on international standards [for] coal classification, and a considerable d[is]cussion of coke shatter and tumbler te[sts]. The consensus was that the latter te[sts] merit further consideration, but t[hat] action along this line should be defer[red] until an expected report becomes availa[ble] of coke evaluation studies recently co[m]pleted under the sponsorship of the Am[eri]can Iron and Steel Institute and [the] American Coke and Coal Chemicals In[sti]tute.

Committee D-6 on Paper and Pa[per] Products (*New York*):

At the recent meeting of Committee [D-6] proposed new tests were recommended [for] approval by the Society on: Determ[ina]tion of Chloride Content of Paper [and] Paper Products; Determination of W[ater] Soluble Matter in Paper; and the De[ter]mination of the Amount of Lint Remo[val] from Paper Towels. A new method [of] test for use in conjunction with the Sp[eci]fication for Filter Paper for Use in Che[mi]cal Analysis (D 1100 T) is in the pro[cess] of being voted upon by the Committee [as] well as a revision of the Method of T[est] for Moisture (D 644).

Several new methods of tests were re[-] viewed by Subcommittee I and accep[ted] for letter ballot. These include a met[hod] for determining moisture expansiv[ity,] 75-degree gloss, and the determinatio[n of] zinc and cadmium in paper. A prop[osed] new method of test for pinholes has [also] been revised in accordance with comm[ents] received from subcommittee letter ba[llot]. A revision of the Methods of Test [for] Ply Adhesion of Paper (D 825) has [been] prepared consisting of a revision [of] Method B, formerly applying to vul[can]ized fiber, which will serve as an alter[nate] to Method A in this standard.

Other projects in progress include a [pro]posed combination of the two exis[ting] methods of conditioning paper and p[aper] products (D 641 and D 685) and a rev[ision] of the test for Bursting Strength of P[aper] (D 774) and the Method of Test for [Re]sistance of Paper to Passage of Air (D [...]).

Subcommittee II on Significance of [Test] Methods, which is responsible for th[e re]vision of the Monograph on Paper [and] Paper Board, reported about half o[f the] manuscripts have been received, and [it is] expected that all will be in the han[ds of] ASTM Headquarters within two mo[nths] for publication.

Committee D-8 on Bituminous W[ater]proofing and Roofing Materials:

Ductility of bituminous mate[rials,] especially its significance as a measu[re of] property, has been under question [for a] long time in ASTM Committee D-[8].

uminous Waterproofing and Roofing iterials. A new approach was decided on, whereby other related properties uld be studied. This will include ten- strength, adhesion, and flexibility.

A new specification for insulating siding, first in this field which the committee considered, has been accepted for bcommittee letter ballot. A new thod of test on emulsions for built-up ofing and water-proofing has been pre- red. This is important as a basis for specification on this material.

It has been considered advisable to con- ct a new series of tests to establish data compatibility of bituminous materials ore agreement can be reached on a oposed test method.

mmittee D-11 on Rubber and Rubber- ike Materials:

Committee D-11 on Rubber and Rub- r-Like Materials and 14 of its subcom- ttees and sections made a very impor- nt decision "to develop specifications for bber compounds for general applica- n." The work of this new group to be pointed should result in purchase speci- ations similar to the existing SAE- STM Specifications for Rubber and Syn- etic Rubber Compounds for Automotive d Aeronautical Applications (ASTM 735–48 T; SAE R 10). There are many plications of rubber compounds in in- strial fields and also in domestic electri- l and mechanical appliances and a need specifications for such applications has en indicated.

Committee D-11 has been serving as the nerican group in connection with the ternational Project on Rubber, ISO chnical Committee 45. At the ISO eeting in Akron in October Committee -11 agreed to undertake work on the fol- wing three subjects:

(1) Investigate the effects of temperature and humidity on hardness of vulcanizates of synthetic rubber and filled rubbers;
(2) Provide information on the effect of humidity on the ply adhesion of rubber articles incorporating synthetic textiles and;
(3) To transmit results of abrasion tests using the extracting method for circulation to the members of the committee.

Committee D-11 is considering directing o other ISO projects covering ozone ing and cold resistance or low-tempera- re tests.

mergency Alternates:

Under Code 12 E on Electrical Products, the Department of Commerce, NPA, hich becomes effective March 15, 1951, bber and friction tape manufacturers e to be permitted to use natural rubber ot to exceed 35 per cent by volume in the aking of tapes. In view of this order, tion was taken by Committee D-11 to bmit to the Society emergency alternate ovisions for the ASTM Tentative Speci- ations for Rubber Insulating Tape D 119 – 48 T) and for Friction Tape for General Use for Electrical Purposes (D 69 – 48 T).

The SAE-ASTM Technical Committee on Automotive Rubber is expected to prepare emergency alternate provisions for the Tentative Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735 – 48 T).

New and Revised Standards:

Three new tentative methods have just been approved, as well as revisions in eight existing methods. The new methods cover compressibility and recovery of gasket materials, discoloration of vulcanized rubber (organic, varnish coated or light colored), and accelerated ozone cracking of vulcanized rubber. All these items will be referred to the Society for immediate acceptance.

Two papers were presented on resilience of rubber, "The Measurement of the Hysteresis and Dynamic Modulus of Elastomers by a Vector Subtraction Method," by G. W. Painter, Lord Manufacturing Co., and a second paper described the Buick machine for forced vibration resilience tests, by Lloyd Muller, Buick Motor Div. The subcommittee responsible decided to develop forced vibration resilience test methods, using types of apparatus described in the papers.

There was an excellent attendance at the meeting of the Subcommittee on Low-Temperature Tests at which Dr. Smith, U. S. Rubber Co., described the T-R test for crystallization and stiffness of polymers at low temperatures. The findings of the Ordnance Department on the T-R test were presented by Gerald Reinsmith. Tests using five wires having different torsion constants (0.125 to 0.500) used in a study of the Low-Temperature Stiffening Test by Gehman Torsional Apparatus (D 1053) was presented by B. G. Labbe, University of Akron. Roger Boyd, representative of Committee D-20 on Plastics, offered a revised test for brittleness temperature of plastics and elastomers under impact. This would replace the present ASTM test D 746.

A section will study the new Pusey-Jones plastometer, which may result in a revised Test for Indentation of Rubber (D 531). Stress relaxation round-robin tests on four gasket compositions varying from high to low relaxation are to be made. A proposed test for low-temperature compression set of vulcanized elastomers covers evaluating the ability of elastomeric vulcanizates which have been compressed at room temperature and then subjected to low temperature (air or carbon dioxide atmosphere) to recover from deformation when taken from the clamping device while still at the low temperature. This characteristic is important in such applications as hydraulic seals on aircraft, submarine hatch gaskets, and hydraulic brake cups.

The Subcommittee on Life Tests has been cooperating with Committee D-20 on Plastics on oven aging tests and also on apparatus for determining volatile loss. A proposed method for volatile loss and specifications for equipment to be used are under study.

The Subcommittee on Protective Equipment for Electrical Workers, which also functions as ASA Sectional Committee J6, reported agreement on specifications for linemen's rubber gloves.

In preparation are new specifications for polyethylene and butyl rubber insulation for wires and cables, and a study is under way of methods of determining insulation resistance and shielding practices.

The Subcommittee on Physical Testing considered at length the use of higher testing speeds and acted to submit a proposed revision in the Methods of Tension Testing (D 412 – 49 T), to read as follows:

> "Rate of travel of the power-actuated grip shall be 20 plus or minus 1 in. per min. and shall be uniform at all times. If conditions allow and a higher rate of separation is desirable an increase up to a 40 in. per min. rate may be used in routine work and notation made on the report, but in case of dispute the 20 in. per min. rate shall be considered standard."

The Subcommittee on Rubber Cements reported completion of new tests for adhesives for brake lining and other friction materials. These methods will cover evaluating the strength and permanence of bonds and measuring the life of bonding cements, tapes, and adhesive film on coated brake linings. These methods are timely in view of the new practices of applying brake lining.

The Subcommittee on Hard Rubber is developing impact tests of asphalt battery boxes. An extensive test program on hard rubber was reviewed and plans made for an intensive study of (1) existing variables in the tensile testing of hard rubber, (2) an accurate and reproducible method of determining elongation, and (3) Rockwell hardness test.

Committee D-16 on Industrial Aromatic Hydrocarbons:

In connection with setting up tests for determining the olefin content by bromine number or similar tests in aromatic hydrocarbons, use will be made of a color indicator method and an electrometric method for determining the bromine number of petroleum distillates, recently completed by ASTM Committee D-2.

Furthermore, since it is anticipated to expand the scope and activities of Committee D-16 so as to include other types of aromatic and heterocyclic compounds, it was decided to submit a resolution for letter ballot vote to the Committee. Subsequently, the title of the Committee would also be changed to "Committee D-16, on Industrial Aromatic and Heterocyclic Chemicals." The ASTM Board of Directors will be asked to approve this step.

Committee D-17 on Naval Stores:

One of the most important actions taken by ASTM Committee D-17 on Naval Stores, was a decision to undertake the preparation of specifications for Rosin and other Naval Stores. The committee has

carried out much research work and developed many standard tests, and now feels that it can render added service by developing purchase specifications.

The committee has completed a number of new and revised definitions of terms used in the Naval Stores Industry. The definitions cover the following terms: Abietic Acid, Rosin, Rosin Type (Sample), Tall Oil Rosin, Spirits of Turpentine, Oil of Turpentine, Polymerization Residue (Sulfonation Residue), Ester Gum, Gloss Oil, Tall Oil Rosin Acids, and Tall Oil Abietic Acid. These definitions, after approval by a vote of the committee, will be presented to the Society in June for publication as Tentative.

The committee recommends the adoption as standard of the Tentative Method of Test for Water in Liquid Naval Stores (D 890 – 46 T), with the important addition of two explanatory notes. The first note will state that the Tentative Method of Test for Water in Concentrated Engine Antifreezes by the Iodine Reagent Method (D 1123 – 50 T), which employs the single Karl Fischer reagent, may be used instead of that specified in Method D 890, provided the reagent is regularly available. However, the solvents and quantities specified in Method D 890 are recommended for use when Method D 1123 is employed. The second note will call attention to the fact that electrometric titration may be used instead of the usual observation of the end point.

The committee decided to undertake a cooperative study of a proposed method for determining unsaponifiable matter in rosin by means of separatory funnel extractions. It was decided to recommend the adoption as standard of the Tentative Method of Test for Unsaponifiable Matter in Rosin (D 1065 – 49 T). Plans were made for additional studies of the Tentative Methods of Testing Tall Oil (D 803–49 T), particularly the analytical methods for low rosin acid content tall oils.

D-18 on Soils for Engineering Purposes

The extensive research in soil testing is continuing to bear more fruit as shown in the approval of three additional methods of test by ASTM Committee D-18 on Soils for Engineering Purposes. These new methods will measure the bearing capacity of soil for static load on spread footings, and repetitive and nonrepetitive static load tests for the evaluation and design of airport and highway pavements.

Looking toward further development of test methods, a section of the committee will have as its objective, standardizing the method for determining the so-called California Bearing Ratio of soils. The reproducibility of test results was stressed in respect to all test methods developed by the committee.

A group of technical papers were presented at the main meeting of the committee. These covered the subjects of identification of clays by staining tests, the effect of particle interlocking on strength of cohesionless soil, and the use of de-aired extended soil specimens for research and evaluation of test procedures.

An important accomplishment of the committee late in 1950 was the publication by the Society of a 430-page book covering Procedures for Testing Soils. This embodied the numerous standard methods developed by Committee D-18 and also presented several dozen other methods used by various authorities and groups in this group but not yet standardized by the committee. The book thus gives an overall picture of many of the more widely used tests to evaluate the properties of soils. There are procedures covering soil exploration and sampling; physical characteristics and identification; physical and structural properties; special and construction control tests for subgrades, base courses, etc.; and soil bearing tests in place and dynamic properties.

Committee E-1.—Shear and Torsion; Hardness and Tension Tests of Metals; Elastic Constants; Low-Temperature Testing of Plastics; Viscosity:

One of the high lights of the meetings in Cincinnati during ASTM Committee Week, of Committee E-1 and its subgroups was the organization of a new task group on shear and torsion tests. F. S. Mapes, General Electric Co., is chairman of the task group. To aid in preparing a research program, a literature survey is being made and a bibliography dealing with shear and torsion tests will be prepared. A survey will be made on the terms and nomenclature, and the types of specimens and apparatus being employed today in shear and torsion testing. Consideration will be given to stress-strain relationships in these tests and also to structural property characteristics.

Hardness Testing:

A new tentative method of test was completed for diamond pyramid hardness (commonly referred to as Vickers) of metallic materials. The method includes an extensive table of D.P.H. numbers for 136 deg square base diamond pyramid load of 1 kg.

A new hardness conversion table for nickel and nickel alloys has been approved for action by the Society in June. This conversion table covers the relationship between diamond pyramid hardness, Brinell hardness, and Rockwell hardness of nickel and high-nickel alloys. These hardness conversion relations are intended to apply particularly to the following: nickel, nickel-copper, nickel-copper-aluminum, nickel-chromium-iron, and nickel-aluminum-silicon specimens finished to commercial mill standards for hardness testing, covering the entire range of these alloys from their annealed to their heavily cold-worked or age-hardened conditions including their intermediate conditions.

Progress was noted on a study of portable indentation hardness tests which may include the portable Rockwell method. Due to production problems now arising as a result of the emergency, active consideration is being given to a rapid ball-indentation hardness test. Studies were repor[illegible] of minimum sheet thicknesses in Rockw[illegible] hardness testing which present a compa[illegible] son of various types of anvils: nam[illegible] steel, carbide, sapphire, and diamond. [illegible]

Tension Testing:

Revised methods of tension testing [illegible] metallic materials (E 8) were studied, [illegible] tending to make them more applicabl[illegible] the testing of copper-base alloy, rods [illegible] bars and steel spring wire, with the ob[illegible] of eliminating separate testing methods [illegible] these materials.

Speed of Testing.—A set of recomm[illegible] dations for speed of testing was compl[illegible] to be included in the Methods of Ten[illegible] Testing of Metallic Materials (E [illegible] These suggest that speed of testing be [illegible] scribed in the following terms: (*a*) rat[illegible] movement of the crosshead of the [illegible] machine when not under load, (*b*) rat[illegible] separation of the two heads of the tes[illegible] machine during a test, (*c*) elapsed time [illegible] completing part or all of the test, (*d*) [illegible] of stressing the specimen, or (*e*) rat[illegible] straining the specimen. They will con[illegible] an explanatory note stating that

> "In writing new standards, or revising [illegible] standards, the ASTM product specifica[illegible] committee will have the responsibilit[illegible] deciding for any given material what me[illegible] of measuring speed of testing is to be [illegible] and of specifying suitable numerical limit[illegible] free-running crosshead speed, rate of sep[illegible] tion of heads during a test, elapsed time, [illegible] of stressing, or rate of straining."

The Task Group on Bibliograph[illegible] Speed of Testing plans a review of cu[illegible] articles.

Bursting Test:

The Task Group on Bursting Test [illegible] sented a progress report of its st[illegible] based on the paper by W. C. Aber[illegible] F. M. Howell, on the "Mullen Bur[illegible] Strength Test as a Means of Determ[illegible] the Strength of Annealed Alum[illegible] Foil" which was published with the [illegible] Report of Committee E-1. The au[illegible] concluded:

"To make a tension test requires a [illegible] for preparing specimens and a testing [illegible] chine for testing them. To ma[illegible] bursting test requires only a M[illegible] Tester. The time required to ma[illegible] bursting test is only about one fourth [illegible] required to make a tension test. The[illegible] therefore, both as to investment in e[illegible] ment and man-hours to conduct the [illegible] is very much in favor of the bursting [illegible]

"It is believed that the relatively s[illegible] Mullen bursting strength test provid[illegible] adequate measure of the strength [illegible] nealed aluminum foil, and it is r[illegible] mended that for those demanding a [illegible] fication requirement of strength, su[illegible] quirement be based on the bu[illegible] strength rather than the tensile stren[illegible]

Elastic Constants:

An interesting report was present[illegible] work done in determining the elasti[illegible] stants of materials. The aim here[illegible] recommend suitable methods for dete[illegible] ing the elastic moduli. This task [illegible]

ıder the chairmanship of Walter Ramırg, Chief of Mechanics Division, Naɔnal Bureau of Standards, has disibuted a questionnaire to a large number ɨ testing and engineering laboratories to ɨtermine the extent of interest in elastic ɨnstants. Laboratories contacted were in ɨe following fields: aircraft manufacɨrers, steel companies, engineering ɨhools, pressure vessel and boiler manuɨcturers, metal producers, shipbuilding ɨmpanies, railroads, aircraft engine comɨanies, bridge builders, textile and plastic ɨanufacturers, automotive companies, ɨbber manufacturers, and electrical ɨanufacturing companies. As will be eviɨnt from this list the task group is conɨdering including both metals and nonɨetals.

Low-Temperature Testing of Elastoɨers.—The Task Group on Low-Temɨerature Testing of Elastomers and Plasɨcs received a comprehensive summary of ɨta from a large number of Government ɨnd industrial testing laboratories. W. E. ɨcoville, U. S. Rubber Co., prepared this ɨmmary, which indicates the greatest ɨterest in these tests in the order indiɨated: (1) stiffness, (2) brittleness, (3) ɨardness, (4) stress relaxation, (5) swelling ɨd shrinkage, (6) tensile-elongation, and) creep. The summary showed that ɨSTM test methods are widely used in ɨw-temperature evaluation of materials. ɨnce there is immediate need for correlaɨon of various methods for low-temperaɨre testing now being used, a task group ɨas set up under the chairmanship of F. M. ɨavan of Armstrong Cork Co.

Viscosity:

There was a final review of a Report on ɨe Principles Involved in the Determinaɨon of Absolute Viscosity. This covers ɨe various principles by which viscosity ɨay be determined in absolute units as ɨpposed to arbitrary or empirical units, ɨd it describes several viscometers that ɨustrate these principles, including capillary, falling body, rotational, and vibrational viscometers. This report is to be published in the 1951 Report of Committee E-1.

A report was received on the Saybolt Furol viscosity test of asphaltic products at high temperatures. Cooperative tests have been made in seven laboratories on several samples at 300, 350, 400, and 450 F. The test data indicate a need for further examination of certain features of the test apparatus and procedure. These will be studied in further round-robin series.

Committee E-4 on Metallography:

It was announced at the meeting of ASTM Committee E-4 on Metallography that the Subcommittee on Definitions has practically completed a glossary of metallographic terms comprising upward of 1500 definitions. The committee will ask the Society to publish this glossary as a separate book.

The committee is also balloting upon new Tentative Methods for Estimating the Average Grain Size of Non-Ferrous Metals and Alloys, Other Than Copper and Copper-Base Alloys. There is now a separate standard on Estimating the Average Grain Size of Wrought Copper and Copper-Base Alloys (E 79). Another activity in the committee is a thorough overhauling of the Recommended Practice for Thermal Analysis of Steel (E 14–33).

As a result of studies of Subcommittee XI on Electron Microstructure of Steel, a progress report on this subject was published by the Society in 1950. This group will soon be ready to issue another progress report covering the microconstituent bainite.

Committee E-7 on Nondestructive Testing:

For the 1952 Annual Meeting of the Society to be held in New York City, Committee E-7 on Non-Destructive Testing is laying the groundwork for an international symposium. The present plan is to invite several papers from nondestructive testing authorities abroad and appoint a panel of American experts to give written discussion of these papers. There is also some discussion of special exhibits during this 50th Anniversary Meeting of ASTM.

Committee E-7 is engaged in writing several ultrasonic and magnetic particle testing methods in two of its subcommittees. The method most nearly approaching completion is one covering magnetic particle testing by the dry powder prod method. The committee is also attempting to establish radiographic standards for steel welds.

Committee E-9 on Fatigue:

For Committee E-9 on Fatigue and its Research and Survey Subcommittees reports were presented by a number of members on conferences, meetings, and projects in the fatigue field, both in this country and abroad. The application of statistical analysis in the field of mechanics of materials was discussed at considerable length.

Failures of tailshafts of ships and structural failures in aircraft pointed to the need for large-scale tests and means of correlation with laboratory tests of small specimens, and a subcommittee was set up to promote work of this kind. Initial steps were taken to develop a current fatigue literature service.

One of the major accomplishments of Committee E-9 was its 86-page Manual on Fatigue Testing issued about a year ago. This represented a consensus of latest thoughts and practices as compiled by the authorities serving on the committee. In that book the committee stated "As we see it, the most important objective of fatigue testing is to build up basic knowledge which will contribute to the design, construction, and maintenance of mechanisms and structures in such a way that they are as free from failures as possible and at the same time are efficient and economical."

Many Papers at Annual Meeting Week of June 18

Atlantic City Technical Program Will Include Seven Symposiums

A LARGE number of techɨical papers are in preparation for the ɨ951 Annual Meeting to be held at Chalɨonte-Haddon Hall throughout the ɨeek of June 18. There are seven forɨal symposiums scheduled, and sevɨal technical sessions will be concenɨated on specific subjects. In addition ɨ the papers, there will be many comɨittee reports, but it is proposed to have ɨese presented and acted upon more ɨriefly than heretofore.

Details of the symposiums were given ɨ the January and February BULLETINS. The subjects to be covered are as follows:

- Flame Photometry
- Structural Sandwiches
- Acoustical Materials
- Consolidation Testing of Soils
- Surface and Subsurface Reconnaissance of Soils
- Bulk Sampling
- Ultimate Consumer Goods

The Society has an administrative committee in this latter field. Some notes on this symposium follow. The particular interest of the Society in this field is indicated rather directly by the scope of the Administrative Committee which reads as follows:

> This committee has for its functions the supervision of the Society's activities in the development of standards for ultimate consumer goods that permit of definitions, test data, or test limitations that can be measured by engineering methods, but not including assemblies except where evaluation of materials or workmanship is concerned.

Ultimate Consumer Goods Symposium

FOR over a year the Admin-

Check on Your Hotel Reservation Form?

MEMBERS who have not received the Hotel Reservation Form for the Annual Meeting by May 4 should write Headquarters for another copy to insure that the material posted early in the month did not miscarry in the mails.

Each member and committee member planning to attend the Annual Meeting should, by early May at least, return the reservation form or write to Chalfonte-Haddon Hall, indicating his room requirements.

istrative Committee on Ultimate Consumer Goods has been planning a Symposium on Determination of Wantability of Consumer Goods. It was planned that the papers would cover both theoretical and practical approaches of this interesting problem. Acting for the committee as chairman of its program group, Mr. Paul S. Olmstead, Bell Telephone Laboratories, Inc., has procured the aid of leading authorities in the Social Science Research Council and has developed two sessions as outlined below:

First Session:

- Determination of Soldier Wants, Joseph Katin, Quartermaster Corps
- A Survey of Food Preferences, P. Palmer Benedict, Quartermaster Corps
- Discussion by David Peryam

Second Session:

- Introduction by Mr. Stauffer, NRCS, who will outline the functions of the committee
- Interviewer Bias, Clyde Hart, National Opinion Research Center, University of Chicago
- Panel Survey Method, P. F. Lazarsfeld, Columbia University
- Effective Sampling Procedures, F. F. Stephan, Princeton University

Technical Papers

AT ITS meeting in February the Administrative Committee on Papers and Publications, which is responsible for the development of the program had a large number of offers before it. After evaluating all of these, several dozen were accepted subject to later review of manuscripts, and the list which follows will give some idea of the topics that may be covered. Many of these will be of particular concern to specific groups in ASTM.

- Surface finish and fatigue life of steel
- Damping, fatigue, and dynamic properties of steel
- Fatigue strength of ball bearing races and simple test specimens of 52100 steel
- Torsion properties and Poisson's ratio for stainless steels
- Notch toughness of low alloy steels; and at low temperatures
- Fabrication of steel piping for 1000–1050 F service
- A new alloy rivet steel
- Creep-rupture of sheet steels
- Instability of steels for elevated temperatures
- Prediction of relaxation of metals for creep data
- Evaluation of materials for marine gears
- Impact arbitration bar for cast iron
- The creep properties of 2S-O alloy; and of some forged and cast aluminum alloys
- Some factors affecting the tension, torsion, and fatigue of beryllium copper wire
- Properties of copper at various temperatures
- Creep characteristics of phosphorized copper
- Apparatus for low-temperature tension tests of metals
- Resonance-type fatigue test equipment
- Effect of the atmosphere on ductility in creep tests
- Studies of die-casting processes
- Changes in characteristics of portland cement from 1904 to 1950
- Automatic apparatus for subjecting concrete to freezing and thawing
- The soniscope for measuring time of set of concrete
- Permeability tests of lean mass concrete
- Abrasive resistance of air-entrained concrete
- Study of aged white coat plaster by thermal analysis
- Cooperative transformer oil study
- Flexometer for bending analysis of fabrics and stiffness studies of thin plastics
- Progressive heterogeneity on aging, in naphthasols of "negative spot test" asphalts
- Properties of exposed and unexposed polyvinyl butyral coated fabrics
- Creep test methods for determining cracking sensitivity of polyethylene polymers
- Elastic calibrating devices
- Fatigue tests as applied by lead cable sheath
- The influence of frequency on the repeated bending life of acid lead
- Compression tests of lead alloys at extrusion temperatures

Provisional Program and Preprints

The complete program of the meeting indicating the days on which the sessions will be held and a list of the subjects for each session will be published in the May BULLETIN as part of the Provisional Program. This issu[e] will go in the mails about May 1[8]. Meanwhile the Staff will have devote[d] intensive work to editing and preparation of the papers so that preprints o[f] them can be made available prior to th[e] meeting. As usual a preprint reques[t] blank will be mailed to each member i[n] good standing in May so that he ca[n] indicate the papers and reports he wishe[s] to obtain. Papers will be mailed i[n] two installments in June.

Hotel Reservations

Early in April there is being maile[d] to each member a hotel reservatio[n] form—see the accompanying box f[or] further notes on hotel rooms.

New Technique on Committee Reports

With the increasing number of AST[M] technical committees, and consequent[ly] a larger number of reports, problem[s] have arisen in connection with the pr[e]sentation of papers at the Annual Mee[t]ing, to provide time on the progra[m]. As a result of continued deliberations [of] the Board of Directors, particularly [its] Committee on Technical Committ[ee] Activities, it has been proposed th[at] this year (1951) the reports are [to] be presented by title only. Thus th[e] reports can be handled promptly, l[o]... presentations will not be necessary, a[nd] if there is a controversial matter, t[his] can be acted on separately.

This procedure carries with it ... commitment that reports must be p[re]printed and distributed well in adva[nce] of the meeting so that the members w[ill] have an opportunity to study all of [the] matters that the committee is coveri[ng].

1951 Marburg Lecture—LaQue on Corrosion

MR. FRANK L. LaQ[ue], noted authority on corrosion, is ... year's choice to present the Marb[urg] Lecture at the ASTM Annual Meeti[ng].

The lecture will comprise a surve[y of] the corrosion-testing programs and ... methods of corrosion testing which h[ave] been sponsored by the ASTM. ... LaQue, who heads the Corrosion ... Section, International Nickel Co., ...

ork, will outline the inadequacies of ccelerated tests and the advantages nd limitations of tests under natural onditions. He will particularly discuss he distinction that must be made between the corrodibility of a material nd the protective value of its corrosion roducts and how these are influenced y both the composition of the material nd the incidental conditions of its exposure. In his discussion the lecturer will feature the following topics:

1. Relation between "acid" and other accelerated" tests and the results of long-time atmospheric corrosion tests on different irons and steels including discussion of riteria of performance and statistical analysis of results.

2. Effects of alloying elements on the atmospheric corrosion resistance of steels.

3. The relationship between the color nd other characteristics of rust films and he durabilities of steels in the atmosphere nd the prediction of performance on basis f rust color.

4. The influence of the corrosion resistance of steel on the performance of aint coatings.

5. The use and relative merits of iron nd zinc corrosion test specimens for calibrating the corrosivity of the atmosphere t different locations and gross variations n corrosivity among atmospheres of the ame type and toward different materials.

6. The use of potential measurements n corrosion studies and the controlling ffects of the peculiar polarization characteristics of different metals and alloys in etermining behavior in galvanic couples.

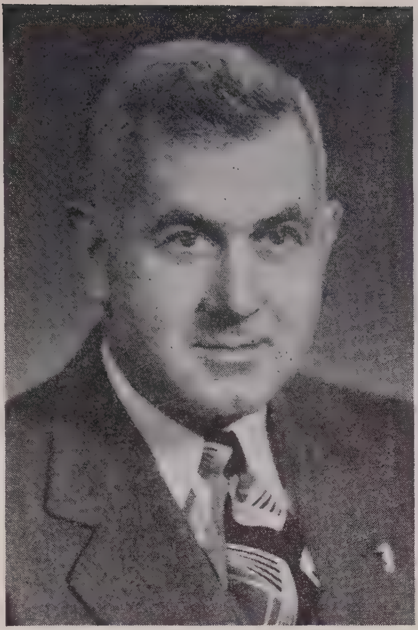
7. Atmospheric galvanic corrosion nd the significance of data from the ASTM tests.

8. The influence of external factors on corrosion of steels under water and the peculiar effects associated with partial mmersion in salt water.

9. The use and abuse of results of salt spray tests and their relation to performance under natural conditions illustrated by appropriate data for metals and coatings.

10. Discussion of advantages and limitations of ASTM methods for the following types of corrosion test:

(*a*) Total immersion,
(*b*) Alternate immersion,
(*c*) Plant tests,
(*d*) Boiling nitric acid,
(*e*) Boiler water embrittlement, and
(*f*) NDHA tester.



Frank L. LaQue

About the Lecturer.—Mr. LaQue attended Queens University, Kingston, Ontario, Can., from where he received in 1927 his B.S. in Chemical and Metallurgical Engineering. Immediately after his graduation, Mr. LaQue entered the International Nickel Co., being assigned to the Development and Research Division. Mr. LaQue has since then held various positions within this particular Division, he was assigned as Assistant Technical Director, handled during the war years the general activities in the Development and Research Division, and is now in charge of the Corrosion Engineering Section. Throughout all these activities, Mr. LaQue has been in close connection with the practical aspects of corrosion and the properties of corrosion-resisting metals and alloys.

Mr. LaQue presently is chairman of the ASTM Advisory Committee on Corrosion, he represents ASTM in the National Association of Corrosion Engineers and also on the Inter-Society Corrosion Committee. Furthermore he serves on Committees A-10, B-3, and D-19 of ASTM. Along with being a member of this Society, Mr. LaQue belongs also to the American Chemical Society, American Society for Metals, National Association of Corrosion Engineers, Society of Naval Architects and Marine Engineers, Electrochemical Society, Technical Association of the Pulp and Paper Industry, British Iron and Steel Institute, Institute of Metals, and American Association for the Advancement of Science.

Time of Lecture: The exact time at which the Lecture will be given has not yet been decided. It has been the practice to schedule this either Tuesday evening or Wednesday afternoon of the Annual Meeting week, which this year would be June 19 and 20. See the May BULLETIN for definite dates.

Many Actions on Standards, January–March, 1951

FROM the accompanying able, indicating actions by the ASTM Administrative Committee on Standards, it will be noted that quite a number of new and revised tentatives and tentative revisions of standards were approved during the period January–March, 1951. The new standard, marked with an asterisk in the accompanying table, appears in Part 5 1950 Supplement to the Book of Standards. The other items will not be included in he Book until the 1951 Supplements appear late this year, but copies in separate form of the new and revised items are available, and members interested in he *new* tentatives may obtain a copy on request without charge by writing to ASTM Headquarters.

Some notes follow on the various recommendations which came from the respective technical committees, this material appearing in order of the designations of the committees.

Hydraulic Lime:

The important change which eventually will be made in the Specifications for Hydraulic Hydrated Lime (C 141) is the edition of a new type of lime (Type B) for which there has been an important demand. While the chemical composition of this new type is somewhat parallel to Type A already in the specification, the average compressive strength of the new type is 175 psi at the age of 28 days, compared with the average strength of 350 psi for Type A.

This revision will not become a part of the standard until Committee C-7 later on recommends the adoption. Meanwhile it is being published as information.

Panel Spalling Tests for Refractories:

In general the proposed revisions in the four Spalling Tests for Refractories will provide more rigorous testing requirements. The changes eventually will prescribe the manner of cooling and dismantling of the panels.

Paint Exposure Panel Forms:

To provide convenient means of recording the results of exposure test paints and in general to standardize on the forms used, a new tentative has been issued based upon the work of the Federation of Paint and Varnish Production Clubs and Committee D-1. The forms have been designated Federation Stand-

ard No. 35, and in ASTM will have the designation D 1150.

Single Panel Form.—The single panel form provides on one sheet the complete exposure record of a paint test panel. It provides a record for a period of 60 months for 15 or more different types of failure. On the front side there are eight graphs upon which the record for practically every type of failure may be plotted. The type of failure is specified on six of the graphs as indicated, and there are two additional graphs for special types of failure that may be required.

Multiple Panel Sheet.—Although the single panel form may be used in the field to record results directly, it is recommended that observation in the field be recorded on the multiple panel inspection sheet and later be transcribed to the single form. Provision is made on the multiple panel form for recording twenty different observations of twenty different panels. The type of failure is to be written in the spaces under the heading "Properties." The back of the sheet may be used for remarks or any additional data that need be recorded.

These single and multiple panel sheets are available from ASTM Headquarters and also from the Federation Headquarters as follows:

Pad of 50 sheets, 8½ by 11 in., single panel, $2; multi-panel, $1.35.
Three pads, single, $4.50; three pads, multi-panel, $3.

Members of the Society may procure a complimentary copy of the single and multiple sheet by writing to ASTM Headquarters. In doing so, please mention the April ASTM BULLETIN and request a free copy.

Sampling Natural Gas:

The new Tentative Method for Sampling Natural Gas developed by Committee D-3 recognizes that a properly selected and representative sampling procedure is essential as the initial step in the analysis and testing of these fuels. The development of this new tentative paralleled the work in establishing the other test methods issued by Committee D-3 covering such subjects as calorific value, specific gravity, analysis by volumetric chemical method and mass spectrometer, and water vapor content. In each case a subcommittee was assigned the subject, and after considerable research and investigation a method was evolved which was subject to corroborative tests in the committee, and finally voted on. A considerable amount of time has been necessary in perfecting these various methods. In the case of the new method (D 1145) the subcommittee was established soon after Committee D-3 itself was organized.

Blocking Point of Adhesive Layers:

Committee D-14 on Adhesives in establishing the new Tentative Method of Determining the Blocking Point of Potentially Adhesive Layers (D 1146) recognized that there was need in the adhesive field for a method directed to an expression of the critical temperature or the critical humidity at which blocking (of a defined degree) occurs. Present methods such as ASTM D 884 – 48 (Method for Estimating Blocking of Plastic Sheets) and TAPPI T 477 – 47 (Blocking Resistance of Paper and Flexible Materials) are directed to an expression of a degree of blocking.

In the method blocking is defined as the adhesion between touching layers of similar or dissimilar material, such as occurs under moderate pressures during storage or use. There are several types of blocking: cohesive, adhesive, first and second degree, etc.

The "Scope" of this method reads as follows:

> "A method is provided for determining the blocking point of a thermoplastic or a hygroscopic layer or coating of potentially adhesive material.
>
> "Since some potentially adhesive materials are both thermoplastic and hygroscopic a method is provided for estimating on the same material both thermoplastic and hygroscopic blockin Because some requirements are mo strict than others, two varying degre of blocking are recognized and define 'Potentially adhesive' materials com prise those materials in a substantiall nonadhesive state which may be ac vated to an adhesive state by applic tion of heat or solvents.
>
> "Two types of blocking are covere (1) blocking of the potentially adhesi face to another similar face, and (blocking of the potentially adhesive fa to a standard test paper."

Plastics:

The five actions developed by Co mittee D-20 on Plastics relate to tent tive methods or specifications althou D 674 was formerly a standard whi now has been reverted to tentati status.

In general, the revised methods D 6 and D 671 involving conditioning a fatigue testing embody improveme and make the methods more compl and up to date.

With respect to the Specificati covering Cellulose Acetate, and Acet Butyrate Molding Compounds, cert classifications in each are discontinu and further requirements are given their properties. For example, in D the three existing types—general p

Actions by the ASTM Administrative Committee on Standards, January–March, 1951

New Tentatives

Methods for:

Sampling Natural gas (D 1145 – 50 T)*
Determining the Blocking Point of Potentially Adhesive Layers (D 1146 – 51 T)

Charts:

Single and Multiple Panel Forms for Recording Results of Exposure Tests of Paint (D 1150 – 51 T)

Tentative Revisions of Standards

Specifications for:

Hydraulic Hydrated Lime for Structural Purposes (C 141 – 42)

Methods of:

Basic Procedure in Panel Spalling Test for Refractory Brick (C 38 – 49)
Panel Spalling Test for High Heat Duty Fireclay Brick (C 107 – 47)
Panel Spalling Test for Super Duty Fireclay Brick (C 122 – 47)
Panel Spalling Test for Fireclay Plastic Refractories (C 180 – 49)

* Published in 1950 Supplement, Part 5.

Revisions of Tentatives

Specifications for:

Cellulose Acetate Molding Com pounds (D 706 – 48 T)
Cellulose Acetate Butyrate Moldin Compounds (D 707 – 47 T)

Methods of:

Producing Films of Uniform Thick ness of Paint, Varnish, Lacque and Related Products on Tes Panels (D 823 – 47 T)
Test for Changes in Protective Coa ings of Paint, Varnish, Lacque and Related Products on Ste Surfaces When Subjected to Im mersion (D 870 – 46 T)
Conducting Exterior Exposure Tes of Paints on Wood (D 1006 – 49 T
Conditioning Plastics and Electric Insulating Materials for Testin (D 618 – 49 T)
Test for Repeated Flexural Stre (Fatigue) of Plastics (D 671 – 49 T

Revision of Standard and Reversion Tentative

Method for:

Long-Time Tension Tests of Plast (D 674 – 48)

ose, heat-resistant, and impact-resistant—are being replaced by types called medium, hard, and soft. In each specification the revised standard laboratory atmosphere is being incorporated. Several other changes relate to conditioning and drying of the test specimens.

The changes in the Long-Time Tension Tests (D 674) will embody a new title indicating this covers creep and stress-relaxation tests. These are important in predicting the strength of materials for resisting loads continuously applied for long times and in predicting dimensional changes. The "Scope" of the revised method is as follows:

> "This recommended practice describes procedures for determining the time dependence of the deformation and strength of plastics specimens resisting long-duration constant tension or compression loads, under conditions of constant temperature and relative humidity and with negligible vibration.
>
> "It also describes a recommended practice for determining the time-dependence of stress (or stress relaxation) of plastics resisting long-duration constant tension or compression strains at conditions of constant temperature and relative humidity and negligible vibration.
>
> "The subject is presented as a recommended practice for guidance rather than a method or specification because the extremely time-consuming nature of the test makes it generally unsuited for routine testing or for specification in purchase of material. This test is therefore confined largely to research testing where standardization is generally undesirable because it tends to retard development of improved methods."

The Revised Methods for Changes in Protective Coatings of Paint, Varnish, Lacquer, and Related Products on Steel Surfaces when Subjected to Immersion (D 870) now require that only distilled water can be used as the immersion liquid for the test of organic coatings on steel and that the test liquid, in order to avoid contamination, should be changed at least every 72 hours or sooner if visible crust or other changes appear. These revisions apply to coated steel panels and to coated steel manufactured articles.

The revision of Tentative Method of Conducting Exterior Exposure Tests of Paints on Wood (D 1006) consists in providing a new test panel for exposure tests of trim paints. The pieces of siding are shortened to 27 in. to make room for two more pieces of trim lumber, 1 by 4 in., at each end, and in narrowing the exposed width of the siding to 4 in. to make room for another piece of trim lumber, 1 by 6 in. across the top.

NOTES ON PUBLICATIONS

1950 *Proceedings* to be Released Soon

The 1950 ASTM *Proceedings*, Vol. 50, which will comprise approximately 1500 pages, including all of the reports of the technical committees, and a large number of technical papers, is going to be mailed shortly. The *Proceedings* will be sent to every member in good standing, whether individual, company, or sustaining.

The first 500 pages of the publication will include the numerous committee reports, including that of the Board of Directors, and its Administrative Committees. One important part is the Edgar Marburg Lecture on "Spectroscopy" which was presented by Dr. Wallace R. Brode of the National Bureau of Standards. There are a great number of technical papers in the field of metals, and several dealing with cement, plastics, and other materials.

While the majority of technical papers were preprinted for distribution prior to their presentation at the Annual Meeting so that members could become familiar with these papers, there were a number that could not be preprinted, including several particularly extensive and important items. Those which were not preprinted are as follows:

- Effect of Variations in Notch Acuity on the Behavior of Steel in the Charpy Notched-Bar Test—N. A. Kahn, E. A. Imbembo, and F. Ginsberg.
- Welding Characteristics of Open Hearth and Bessemer Seamless Pipe—A. B. Wilder, W. B. Kennedy, and F. W. Crouch.
- Welds Between Dissimilar Alloys in Full Size Steam Piping—R. U. Blaser and F. Eberle.
- Some Considerations in the Joining of Dissimilar Metals for High Temperature Service—O. R. Carpenter, N. C. Jessen, J. L. Olberg, and R. D. Wylie.
- A Synthetic Sea Water and Its Corrosion Characteristics in Salt Spray Testing—T. P. May and A. L. Alexander.
- The Forming Characteristics of Beryllium Copper Strip—J. T. Richards and E. M. Smith.
- Magnesium-Cerium Cast Alloys for Elevated-Temperature Service—K. Grube and L. W. Eastwood.
- Aluminum—6 Per Cent Magnesium Casting Alloys for Elevated-Temperature Service—L. W. Eastwood, W. Hodge, and C. H. Lorig.
- Interpretation of High Temperature Alloy Stress-Rupture Data—J. M. Cameron and W. J. Youden.
- Strength of Metals and Alloys at Elevated Temperature—M. J. Manjoine.
- Effect of Temperatures on the Mechanical Properties, Characteristics, and Processing of Austenitic Stainless Steels—V. N. Krivobok and A. M. Talbot.
- Chromium-Base Alloys—W. L. Havekotte, C. T. Greenidge, and H. C. Cross.
- Testing Cement-Base Paints and Dampproofers—W. Spurgeon.
- Exploratory Tests to Develop a Method for Determining the Air Content of Hardened Concrete—A. Klein, D. Pirtz, and M. Polivka.
- A Flaw Detector for Tubes—R. J. Kodis.

In regard to the above-mentioned papers it might be well to point out two papers which received considerable attention and which were discussed jointly. The presentations mentioned are: "Welds Between Dissimilar Alloys in Full Size Steam Piping" and "Some Considerations in the Joining of Dissimilar Metals for High Temperature Service."

Pacific Meeting Papers: Important additions to the 1950 *Proceedings* are several extensive papers given at Pacific Area National Meeting. These papers are listed below:

- Electrical Resistivity Method Applied to the Investigation of Construction Materials Deposits—E. A. Abdun-Mur and D. Wantland.
- Effect of Rock Content and Placement Density on Consolidation and Related Pore Pressure in Embankment Construction—H. J. Gibbs.
- Fatigue Notch Sensitivities of Some Aircraft Materials—H. Grover.
- Why Type II Cement—F. H. Jackson.
- Long-Time Study of Cement Performance in Concrete with Special Reference to Heat of Hydration—G. J. Verbick and C. W. Foster.
- Fatigue Strength of Steel Through the Range from ½ to 30,000 Cycles of Stress—M. H. Weissman and M. H. Kaplan.

Included in the *Proceedings* are discussions of many of the technical papers. Through these discussions additional information not included in these papers is brought out, and sometimes they present additional supporting evidence, or, as frequently is the case, these discussions may include a word of caution on certain interpretations.

To facilitate easy reference to specific parts or subjects in the *Proceedings*, there are included detailed subject and

author indexes. The publication is bound in dark blue cloth; nonmembers of the Society may purchase the *Proceedings* at $12 per copy, and members can secure *extra* copies at $8.

1950 Supplement to 1949 Book of ASTM Standards

Four supplements to the book of ASTM Standards have been published recently. The remaining two are in the process of being printed and will be released shortly. The published supplements are Part 1 on ferrous metals, Part 2 on non-ferrous metals, Part 4 on paint, naval stores, wood, adhesives, paper, shipping containers, and Part 6 on electrical insulation, plastics, and rubber. Part 3 on cement, concrete, ceramics, thermal insulation, road materials, waterproofing, soils, and Part 5 on textiles, soaps, fuels, petroleum, aromatic hydrocarbons and water will be published in April.

The 1950 supplements bring up to date, amplify, and complete the 1949 Book of ASTM Standards. There are altogether 365 standards contained in the supplements of which over 100, covering many important materials and subjects, are published for the first time. Some of the other standards are replacements of existing standards, some are extensively revised, while new and revised tentatives are also included. Furthermore, listed but not published are tentatives, which without revisions have been adopted as standards during 1950.

All supplements are bound in heavy paper cover and are priced at $3.50 to nonmembers and $2.75 to members.

Benzene, Toluene, Xylene, and Solvent Naphtha

The latest edition of the compilation of Standards on Benzene, Toluene, Xylene, and Solvent Naphtha, sponsored by ASTM Committee D-16 on Aromatic Hydrocarbons, is now off the press. The compilation contains all of the many ASTM specifications and methods of test pertaining to industrial hydrocarbons. This publication includes twelve specifications and nine approved test methods which incorporate some minor changes and additions.

While this compilation was originally issued as a special publication for a number of producers industrial aromatic hydrocarbons, t great interest shown by others worki with these compounds warranted general distribution. The booklet bound in heavy paper and is available the price of $1.50 to nonmembers a $1.15 to members.

Standards on Industrial Waters

Just off the press is t latest compilation of ASTM Standar on Industrial Water, prepared by AST Committee D-19. The publication ou lines various ASTM standards and te tative methods of sampling, analys and testing of industrial water. Th methods are applicable particularly the testing of water used industrially the generation of steam or for process cooling purposes, and for the analysis residues deposited by such waters.

In a number of established standar some minor changes and additions w incorporated, while one new method test has been adopted and several ten tive methods have been issued. T standard adopted deals with methods testing industrial water for total alu

Temperature Reading

Water and Sediment

The illustrations on this and the next page are from the new ASTM Manual on Measurement and Sampling of Petroleum and Petroleum Products published early in 1951. The standards embodied in this publication are of much importance to both the purchaser and the producer of petroleum and its products. The book gives available information for measuring quantities of petroleum and for obtaining representative samples. There are six ASTM methods, the book aggregating 132 pages. The Manual is the result of study and investigations over a number of years.

Gravity

Sampling

um and aluminum ion. New tentative methods issued in this compilation are: Test for the electrical conductivity, test for hardness, test for sodium and potassium, method of identification of types of microorganisms, definitions of terms relating to industrial water, and specification for substitute ocean water.

The publication, bound in heavy paper, is available at the price of $2 to nonmembers and $1.50 to members.

Science and Tomorrow

FIFTEEN papers written on expected scientific developments by the leading authorities in several fields of science and technology constitute a symposium, "Science . . . and Tomorrow," appearing in the current issue of the *Journal* of The Franklin Institute.

Commemorating its 125th year of unbroken publication, this *Journal* published by the Franklin Institute, is one of the oldest scientific journals in the United States.

The commemorative issue is intended to predict future developments in science and technology based upon the considered opinions of today's leading authorities. A short review of some of these 15 papers is given below:

Dr. Harold C. Urey of the Institute for Nuclear Studies, University of Chicago, in describing advances in the field of chemistry writes that "somewhere in the future, whether it is the remaining years of this century or years to follow, man will have an understanding of the origin of life. . . ."

From Columbia University comes a statement by Dr. I. I. Rabi, Professor of Physics, that "Still higher energy ranges, the billion electron volt region, will be available in a few years and in the next ten or twenty years elementary particle phenomena will be well understood from the experimental point of view."

Dr. Jerome C. Hunsaker of Massachusetts Institute of Technology predicts that the helicopter may ultimately replace the airplane for short feeder-line flights; that turbo-propeller airplanes will serve normal intercity traffic, and that transcontinental and transoceanic flights will be in very high altitude turbojet planes of very high speed. Dr. Hunsaker also believes that a six hundred miles per hour cruising speed is not unreasonable.

Television comes in for its share of prophecy from a scientific point of view. Dr. Oliver E. Buckley, President of the Bell Telephone Laboratories, mentions some uses to which it may be put outside of the broadcast field such as the observation of industrial processes at a distance, display of goods to customers at remote places, and face-to-face conferences of dispersed individuals or groups. He feels that one puzzling question needed to be solved regarding television is the extent to which it may some day come to be an adjunct to ordinary person-to-person telephony.

Dr. Buckley ends by writing that "there is no reason to believe that the capacity of human brain power for uncovering new knowledge and applying it to useful ends is approaching a limit. The benefits to society will depend far more on the capabilities of humankind in general for making use of what is made available than on the capabilities of scientists and engineers for making new devices."

The use of radiant energy with the production of carbohydrates as a principal source of our heating fuels, foods, and combustion engine fuels is expected by Dr. Wallace R. Brode, Associate Director of the National Bureau of Standards.

Dr. E. U. Condon, Director of the National Bureau of Standards, foresees the establishment of a complete set of primary atomic standards. He feels that it will be possible to adopt new standards, atomic in nature, in the coming years.

Charles F. Kettering, Director and Research Consultant, General Motors Corp., assures in his paper on transportation that "this thing of greatly increased economy through high compression ratios is not just an impractical experiment in a research laboratory. These very large gains (35 to 40 per cent better economy in miles per gallon in high compression cars) which become simply enormous when we consider the millions of passenger cars manufactured each year, will be available to the motoring public as soon as the petroleum industry can supply large quantities of fuel with sufficiently high anti-knock value."

ASTM Bulletin

APRIL 1951

NO. 173

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Nominations for Officers

THE Nominating Committee to select nominees for Society officers met in Philadelphia on March 2. The personnel of this group was listed in the October, 1950 BULLETIN. In accordance with the provisions of the By-laws of the Society the following nominations are announced:

For President (term 1 year):

T. S. FULLER, Engineer in Charge, Works Laboratory, General Electric Co., Schenectady 5, N. Y.

For Vice-President (term 2 years):

L. C. BEARD, JR., Chemist, Socony-Vacuum Oil Corp., Inc., 26 Broadway, New York 4, N. Y.

For Board of Directors (term 3 years):

J. W. BOLTON, Director of Metallurgical Research and Testing, The Lunkenheimer Co., Beekman and Waverly Sts., Cincinnati 14, Ohio.

R. A. SCHATZEL, Vice-President and Director of Engineering, Rome Cable Corp., 330 Ridge St., Rome, N. Y.

E. O. SLATER, President and Manager, Smith-Emery Co., 920 Santee St., Los Angeles 15, Calif.

STANTON WALKER, Director of Engineering, National Sand and Gravel Assn., 1325 E St., N. W., Washington 4, D. C.

F. P. ZIMMERLI, Chief Engineer, Barnes-Gibson-Raymond, Division of Associated Spring Corp., 6400 Miller Ave., Detroit 11, Mich.

Each of the above nominees has indicated in writing his acceptance of his nomination. The By-laws provide that "further nominations, signed by at least 25 members, may be submitted to the Executive Secretary in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

Prior to the meeting of the Nominating Committee a communication was received from Professor Frank E. Richart, Senior Vice-President of the Society, suggesting that, for reasons of health, his name be not considered as a possible nominee for President. While Professor Richart has recovered greatly from a severe heart attack that he suffered in 1949, nevertheless consideration of the duties and responsibilities of the presidency led him regretfully to take the step that he did. The Nominating Committee in reluctantly acceding to this request has expressed to Professor Richart its deep regret over these circumstances, as the honor of the presidency is one which he has richly earned by his high attainments and outstanding contributions to the Society. We are sure that the entire Society will share this feeling and our best wishes go to our esteemed Vice-President for continued improvement of his health.

Announcements Concerning the Headquarters Staff

ANNOUNCEMENT was made recently of the following advancements in the Technical Staff, effective March 1:

G. A. Wilson, to the position of *Senior Assistant Editor*
M. D. Huber, to the position of *Assistant Standards Editor*
J. W. Caum, to the position of *Assistant Technical Secretary*

These three men have been members of the Staff for a number of years, and Mr. Wilson, formerly Assistant Editor, is a 25-year Staff member.

Messrs. Huber and Caum have been concerned largely with editorial and committee contact work, Mr. Huber's interests primarily being with chemical analysis and the field of chemical products, Mr. Caum's efforts being concentrated in the field of ferrous and non-ferrous metallurgy.

New Member of Staff:

In addition to the above Staff changes, there is a new member of the Technical and Editorial Staff, Mr. W. W. Menz, who will be concerned with editorial work largely in connection with technical papers and the news section of the ASTM BULLETIN. A graduate of the University of Munich, he later studied at Ohio State and Xavier University. As a member of the United States Air Force, he saw extensive service in the Pacific in the recent war. For the past five years he has been engaged in technical writing, abstracting and publishing, first as chief of the Abstracting Branch, Central Air Document Office, of the Air Force at Wright Field, and later as Editor of Public Health Engineering Abstracts for the U. S. Public Health Service. Mr. and Mrs. Menz and their two young children are now living in Philadelphia.

Sustaining Membership

WE ARE pleased to announce the recent assumption of sustaining membership by three organizations active in the Society for many years: A. M. Byers Co., Pittsburgh, Pa., affiliated through company membership since 1914; Pacific Gas and Electric Co., San Francisco, Calif., whose company membership dates from 1923; and Universal-Cyclops Steel Corporation, Universal Division, Bridgeville, Pa., with affiliation since 1920. All three companies have participated through the years in many ASTM technical groups.

The Board of Directors of the Society is appreciative of the support and continuing interest of its sustaining mem-

Schedule of ASTM Meetings

DATE	GROUP	PLACE
April 10	Executive Committee	Philadelphia, Pa.
April 16–17	Committee D-10 on Shipping Containers	Atlantic City, N. J.
April 19–20	Committee B-1 on Wires for Electrical Conductors	Washington, D. C.
April 20	New York District	New York, N. Y.
April 21	Committee C-21 on Ceramic Whiteware	Chicago, Ill.
April 23–24	Committee D-14 on Adhesives	Washington, D. C.
April 24	St. Louis District	St. Louis, Mo.
April 26	New England District	Hartford, Conn.
May 2–3	Committee D-21 on Wax Polishes and Related Materials	Chicago, Ill., and Racine, Wis.
May 3	Detroit District	Detroit, Mich.
May 7–8	Board of Directors	Philadelphia, Pa.
May 21–22	Committee E-11 on Quality Control of Materials	Cleveland, Ohio
June 18–22	Annual Meeting	Atlantic City, N. J.

rs. Some of the advantages of a sus-ning membership have been noted om time to time, these privileges in-uding receipt of a complete set of all blications issued by the Society and extra complete set of the Book of STM Standards on request. All the ivileges of a company membership so apply to the sustaining class. rough the annual dues of $150 the staining members contribute an im-rtant portion of the Society's income om dues. Within the last few weeks a mber of industrial organizations who ve been affiliated with the Society rough company membership have en invited to consider the sustaining embership class. Further information ncerning this class will be sent to any ganization interested.

Our May BULLETIN will list more news Sustaining Members.

ibliographies and eferences—We Have hem!

WHILE it is not too good analogy to compare a list of references d bibliographies in a technical paper the same way as one associates butter th bread, nevertheless in many of the pers which the Society publishes the tremely extensive lists of references ntribute a very similar completeness. hen this article was drafted we did t know whether or not first place ould be taken by the one appended to e paper by Messrs. Hastings and arter dealing with the Inspection, ocessing and manufacturing Control Metals by Ultrasonic Methods pub-hed in our 1948 *Proceedings* and re-inted in the new Symposium on Ultra-nic Testing. It has 342 important ref-ences. Now with the issuance of the mposium on the Role of Non-De-ructive Testing in the Economics of oduction we know that the extensive per by McMaster and Wenk on "A asic Guide for Management's Choice Non-Destructive Tests" has almost 0 references with several lists given each of the twelve sections of this onumental paper.

The value and significance of bibli-graphies of this kind can hardly be eremphasized. In the case of Messrs. astings and Carter, they have listed e major available technical articles rough 1946 on ultrasonics as applied metals. McMaster and Wenk have unded out each of the sections of eir paper with pertinent references. or example, there are 201 citations aving to do with penetrating radiation ondestructive tests.

The recently issued Symposium on Nature, Occurrence, and Effects of Sigma Phase also has numerous lists of references appended to the several papers which comprise it.

One can get considerable helpful information from the study of references: for example, a list of those who have been doing active work in the particular field, some conception of the amount of current material that has been published, an idea of journals and societies which are concerned with the problem.

Everyone will no doubt agree on the value of the inclusion of these lists of references. Most of the credit for the inclusion, of course, should accrue to the author, but it is probably only right that mention should be made of the emphasis placed upon this subject by the Papers and Publications Committee. If there is one feature that can be singled out as the cause of most criticism in the review of manuscripts—sometimes resulting in rejection—it is that the papers are not adequately tied in with previous work. It is usually only in the light of what has gone before that the work has significance.

Advantages of Standards in Purchasing

Pacific Purchasor: January, 1951, includes an interesting short paper on "The Advantages of Standards and the Benefits to Be Secured by Their Use in Purchasing" by George M. Rice, Purchasing Dept., Lincoln Mercury Div., Ford Motor Co., Detroit, Mich. A few notes on this follow:

From the Purchasing point of view, standards accomplish the following benefits:

1. The use of specifications and other standards simplifies and clarifies every step in the procurement process—from the planning stage to the mailing of the check in payment for goods.
2. Standard specifications are the result of much experience, trial, and study, thus saving time and effort in determining needs.
3. Standards lower unit costs by making mass production possible because they allow materials to be made in large quantities in one setup.
4. Standards enable buyer and seller to speak the same language and make it possible to compel competitive sellers to do likewise.
5. They broaden competition and promote fairness because comparisons can easily be made.
6. By eliminating unnecessary types, grades, and sizes standards enable purchasers to operate on smaller inventories at less expense, to buy in more economical quantities, and to get better deliveries. Inventory is a very important item with every company. Large amounts of working capital can be tied up in inventories, and costly handling and rehandling can accrue from these excessive inventories.
7. Standards reduce the cost of maintenance and repairs because fewer parts and supplies have to be carried in stock.
8. Without standards no Purchasing Agent could function efficiently. Our industrial life as we know it would be impossible. Each simple purchase would require sketches, blueprints, and pages of specifications.

All these advantages increase as the use of standards increase.

Numerous examples of cost reductions through effective use of standards were given. One aircraft company saved about $270 per plane simply by changing from a special company bolt design to an industry-wide standard. Another large company saved $25,000 in one year by reducing the varieties of metal washers in their inventory. Mr. Rice concluded: "I am sure that as time goes on the Purchasing Agent who places his confidence in a well-organized standards program will find he is doing the best possible job for his company."

Weather and the Building Industry

A COPY of the Proceedings of the Research Correlation Conference held January 11 and 12, 1950, under the sponsorship of the Building Research Advisory Board, National Research Council, has been received. This publication, Report No. 1, covers the first Research Correlation Conference of the BRAB which is the newest activity of the National Research Council. These Proceedings consist of an unusual collection of papers prepared by men whose names have top rank in building technology and the weather sciences. The subject of Weather and the Building Industry was chosen because weather and climate affect research in virtually all fields of building technology. The subject illustrates the aim of the Board to bring men from building research together with those of other fields for the purpose of exchanging ideas and furthering cooperation in research.

An idea of the coverage of the many papers presented at the Conference and included in the publication may be obtained from the titles of the several discussion periods: Reports on Recent Climatological Data; How Can the Weather Sciences Be Developed for Better Use in the Building Industry?; Climate and the Structure; Climate and Design of Buildings; Climate and Indoor Comfort; Summary of the Conference. It is our understanding that copies of these Proceedings can be obtained through the office of the BRAB, 2101 Constitution Ave., Washington 25, D. C., at the price of $3.50 per copy.

Notes on District Meetings

Metallurgical Development, Forest Products Featured

AT A meeting in Philadelphia on February 20 sponsored by the Philadelphia District, W. A. Reich, Metallurgical Engineer, General Electric Co., Schenectady, N. Y., gave an interesting paper on "Metallurgical Development." On that same night, in St. Louis, President Markwardt gave his talk on "Highlights of Progress in Forest Products Research." Subsequently, in Portland, San Francisco, and Los Angeles, the President spoke at technical meetings. In Portland and Los Angeles he covered "Highlights of Progress in Forest Products Research," in San Francisco his talk was on "Wood as an Engineering Material."

There were about 60 in attendance at the dinner in Philadelphia when R. B. Rohrer, Assistant Director of Research, Armstrong Cork Co., and Chairman of the program committee for the meeting, gave his coffee talk on "The Cork Industry." Some notes on this talk appear below. There were about 125 at the technical session when Mr. Reich, who is also Chairman of ASTM Committee B-9 on Metal Powders and Metal Powder Products, gave his paper. District Chairman Schaefer opened the meeting. The speaker was introduced by Howard S. Phelps, Philadelphia Electric Co., who, with Mr. Rohrer, was instrumental in arranging the program. An abstract of the paper by Mr. Reich will appear in the next issue.

Advice directly from President Markwardt indicated that anyone who came out to the St. Louis meeting on February 20 to hear him had real courage and fortitude. Apparently there was a veritable cyclone that had been blowing most of the day with terrific rain, and Mr. Markwardt was gratified at the attendance even though on the low side. Messrs. Roberts and Magruder, St. Louis District Officers, planned this meeting, and there would have been unquestionably a fine attendance except for old man weather, who went on a bad rampage all that day and night.

There is a separate article dealing with West Coast meetings.

News accounts of late March and April district meetings will appear in the May Bulletin.

District Meetings Scheduled for New York and Detroit

FROM the accompanying Schedule of ASTM Meetings it will be seen that the districts in New York and Detroit have technical meetings scheduled with interesting technical programs assured. A few notes on these meetings follow:

New York, April 20—"New Synthetic Fibres and What They Mean to Us"

The general topic for the New York meeting is a current picture of synthetic fibres. Contributing to the interest of the program will be the following authorities in the field: Joseph Quig, E. I. du Pont de Nemours & Co., Carl Setterstrom, Union Carbide & Carbon Corp., and Arthur Etchells, Hellwig Dyeing Corp., C. W. Bendigo, American Cyanimid Co., is the Technical Chairman and G. K. Lake of the Pepperell Mfg. Co. the Program Chairman.

The meeting will be held in Room 502, Engineering Societies Building 29 West 39th St., New York City, at 7:30 p.m.

Detroit, May 3—"High Temperature Metals"

ASTM Past-President Dr. A. E. White, Professor of Metallurgical Engineering and Director of Engineering Research, University of Michigan, will be the technical speaker at the annual meeting sponsored by the Detroit District at the Rackham Memorial Building, 100 Farnsworth, Detroit, on May 3. An outstanding authority on the use of both ferrous and non-ferrous metals for high-temperature service, and particularly in connection with the electric power field, Dr. White is going to talk on "High Temperature Metals."

President L. J. Markwardt, Assistant Director, U. S. Forest Products Laboratory, will also be at this meeting and give a dinner talk which will precede the technical session. Other Society officers will be in attendance.

The Detroit District usually plans one spring meeting on a subject of widespread interest and extends invitations to the membership not only of ASTM but the chapters and sections of other engineering societies in the Detroit area. There is a very active group on the Detroit District Council and considerable emphasis is placed on their annual spring meeting.

Cork Industry

ON FEBRUARY 20 the mem[bers] and guests of the Philadelphia Distri[ct] Council heard Mr. Robert Rohrer, Assist[ant] Director of Research, Armstrong Co[rk] Co., speak on a subject close to his hear[t], cork. Realizing that cork as an engineer[ing] material was not too familiar to man[y] of his listeners, Mr. Rohrer avoided tec[h]nical detail and began with a brief descri[p]tion of cork as an agricultural cro[p]. Among other things, he pointed out th[at] the cork oak presumably develops [a] "cork overcoat" in order to protect it fro[m] the hot, dry winds which occur in the lan[d] to which it is native. He then provid[ed] some notes on the historical significance [of] cork indicating that cork was used in a[n]cient Egypt for cork sandals and headr[est] cushions.

Mr. Rohrer mentioned that most of [the] usefulness of cork results from its cellul[ar] structure, a characteristic uncommon [in] vegetable structures. The excellent fr[ic]tional property results from the fact th[at] when cork is cut in any direction the a[ir] filled cells are sectioned forming t[iny] vacuum cups. The toughness of the [in]dividual cells gives cork its compressibili[ty], it imperviousness to most liquids, and a[lso] its light weight.

The use of cork for bottle closures [is] still important, although in recent ye[ars] the use of the metal crown with its c[ork] disk has become the universal seal for c[ar]bonated beverages. Mr. Rohrer spoke [in] some detail, of the difficult and exact[ing] problems involved in this use of c[ork]. These difficulties, he pointed out, h[ave] been surmounted while keeping the co[st of] the individual cap at an amazingly [low] figure.

Around the turn of the century, [the] growth of the mechanical refrigeration [and] internal combustion engine industries g[ave] cork two new and important applicati[ons]. Cork board is today the standard ins[ula]tion for low temperatures, largely a[s a] result of the use of "baked cork" havin[g] much lower thermal conductivity th[an] ground cork used as a loose fill in wal[l] refrigerators. The internal combus[tion] engine requires a large number of oil [and] waterproof seals and gaskets. The g[ood] compressibility, high recovery, and [fric]tional characteristics of cork have ma[de it] ideal for this purpose.

Mr. Rohrer described the part tr[adi]tionally played by cork in linoleum m[anu]facture, and went on to describe the [newer] modern types of floor coverings which h[ave] been developed to supplement, an[d in] some cases supplant, linoleum.

Though the more important uses of [cork] were spoken of in detail, a numbe[r of] interesting, but less important uses [were] referred to. Among these were: cork [used] between the outer and inner soles of sh[oes], cork spheres in official league baseb[alls], and floats for buoys, fishing nets, and [gau]ges.

Mr. Rohrer ended his interesting and informative talk with a very generous invitation to those present to visit his firm's new research laboratories which are scheduled for completion late this summer.

Members Greet President, Executive Secretary, on West Coast Trip

Interesting Meetings in Portland, Ore., San Francisco, and Los Angeles

AT MEETINGS in Portland, Ore., on March 8; in San Francisco on March 13; and Los Angeles on March 16, President L. J. Markwardt and Executive Secretary C. L. Warwick were greeted by groups of members and others interested in work in materials. These meetings had been arranged in connection with a West Coast trip of the two Society officers.

Portland, Ore:

At the meeting in Portland, T. K. May, Director of Technical Service, West Coast Lumbermen's Assn., presided. He served as chairman of the local committee on arrangements, together with Prof. S. H. Graf, Director, Engineering Experiment Station, Oregon State College, and W. B. Kirby, Chief Engineer, Electric Steel Foundry Co. President Markwardt at this meeting was the technical speaker discussing "Highlights of Progress in Forest Products Research." Because wood is a chief product of Oregon, there was much interest in the President's address and actually quite a few of the some 75 members and guests present are occupied in the timber industry.

At this meeting and subsequently in San Francisco and Los Angeles, Mr. Warwick spoke on "Highlights of Current ASTM Work in Materials."

The officers during their two-day stay in Portland visited a number of our members and inspected various plants including the Electric Steel Foundry and Timber Structures, Inc. On Friday, March 9, the President and Executive Secretary visited Oregon State College as guests of Prof. Graf and viewed the many fine laboratories of that institution, including the U. S. Northwest Forest Products Laboratory located on that campus. The President and Executive Secretary spoke briefly to a group of students and faculty assembled by Professor Graf.

San Francisco Meeting:

The meeting in San Francisco, arranged by the Northern California District Council, was a joint one with the Structural Engineers Association of Northern California. Among the some 150 members of the two societies and guests were several officers of local chapters of other national organizations. Among these were the following: Ralph N. Pollack, President, Northern California Chapter, American Institute of Architects; G. M. Simonson, President, Consulting Engineers Association; S. A. Knapp, Chairman, San Francisco Section, American Institute of Naval Architects; H. P. Stewart, Vice-Chairman, San Francisco Section, American Institute of Naval Architects; Joseph Smith, President, Northern California Chapter, Society of Plastics Engineers; Arthur Cramer, President, Golden Gate Paint and Varnish Production Club; Theodore Vermuelen, Councilor, California Section, American Chemical Society; C. T. Wiskocil, President, San Francisco Section, American Society of Civil Engineers; Ray Schreck, Vice-Chairman, Forest Products Research Society; W. W. Weber, U. S. Forest Products Laboratory, Retired; and L. N. Ericksen, Forest Utilization Service.

At the dinner served at the Engineers' Club, Mr. John E. Rinne, President of the Structural Engineers, introduced the various guests including those noted above. L. A. O'Leary, W. P. Fuller and Co., Chairman of the ASTM District, then introduced the Executive Secretary who outlined a number of the highlights of current ASTM work.

For the technical session, P. V. Garin, Southern Pacific Co., Vice-Chairman of the District and Program Chairman, introduced Mr. Markwardt. His topic for this meeting was "Wood as an Engineering Material," presented in his usual entertaining and effective manner. There were a number of interesting questions and discussions at the session.

During the course of the officers' visit to San Francisco, a well-attended luncheon meeting of the Council was held at the Fairmont Hotel on Monday, March 12, at which plans were discussed for a fall meeting of the District. Arrangements for carrying on membership work were also reviewed.

At this meeting Frank M. Harris, a long-time member of the Council and Chairman of the District, 1936–1942, was elected an honorary council member in recognition of his valued services.

Mr. Carey Ramey, Standard Oil Co. of California, who is heading up the Northern California Membership Committee, succeeding James T. Kemp, who has returned to Washington, later reviewed the work of his group in some detail with the two visiting officers.

The President and Executive Secretary visited a number of members during the course of their five-day stay in San Francisco. On Wednesday, March 14, they were guests of Stanford Research Inst.—a member of ASTM—and inspected the modern and interesting laboratories devoted to the problems of air and water pollution. A visit to Stanford University as the guest of Prof. Harry A. Williams was made the same day.

Los Angeles:

The dinner meeting in Los Angeles at Roger Young Auditorium on March 16 followed a pattern similar to the two other West Coast meetings. There were about 100 members and guests present. C. M. Wakeman, Testing Engineer, Los Angeles Harbor Dept., Chairman of the Southern California District, introduced the various members of the Council and ASTM Past-President W. M. Barr, retired quite recently from the Union Pacific Railroad, and now a resident of Los Angeles where he is Consultant for Richfield Oil Corp.

The President and Executive Secretary were the principal speakers, Mr. Markwardt covering "Highlights of Progress in Forest Products Research" and the Executive Secretary covering "Features of Current ASTM Work in Materials." There were quite a large number of questions at the meeting and many of the audience examined the exhibits which the President used to illustrate his address.

There were a number of wives of council members present at the meeting, including Mrs. Emmons, Mrs. Niesley, and Mrs. Delmonte.

Again in Los Angeles the President and Executive Secretary took advantage of their visit to call on a number of members and plants. There was an interesting inspection tour of the Los Angeles Harbor at Wilmington, accompanied by a number of members and councilors, and during their stay, which a note from the Executive Secretary indicates was a busy and profitable one, they were able to visit among other organizations and institutions the following: Smith Emery Co., California Testing Labs., Northrup Aircraft, North American Aviation, Aircraft Industries Assn., C. F. Braun and Co., and California Institute of Technology at Pasadena.

Leaving Los Angeles, President Markwardt returned to Madison *via* San

Francisco, where he spent several days with his associates of the U. S. Forest Service at Berkeley, Calif. The Executive Secretary went on to visit with and address members of the Society in Dallas, Houston, and Birmingham. He will return to the office on April 2 after a swing of some 7000 miles.

District Meeting in Hartford, Conn.

Subject: Corrosion

As this Bulletin nears press we have been advised of a technical meeting sponsored by the New England District to be held in Hartford, Conn., on Thursday, April 26. The technical speaker is Doctor H. H. Uhlig, Professor of Metallurgy, Massachusetts Institute of Technology, one of the country's outstanding authorities in his field—his subject: "Corrosion; Its Effects on the Properties of Metals." All New England members and selected groups in the New York District are getting direct mail notices. Dinner at 6 P.M. at the Canoe Club; technical session, 8 P.M.

Printer's Error in January Bulletin

A particularly embarrassing printer's error occurred on page 94 of our January issue. The half-page ad of the Posey Iron Works featuring "Lancaster Mixers" contained the following headline as printed: "OR PRODUCTION PREPAREDNESS." The headline should have read, "FOR PRODUCTION PREPAREDNESS." We regret this error particularly since we are informed that these accurate "Lancaster Mixers" seldom make mistakes.

We might also note that in resetting the heading on the President's Message in this fateful (not frightful) issue the "t" was dropped off President Markwardt's name, discovered much to our chagrin when we saw the printed copies (which he, however, took in his good-natured stride).

Perhaps we will close this note with a quotation from our printer's magazine referring to a quip by Ronald Coleman, namely, "The difference between manslaughter and man's laughter rests only in an apostrophe and a space, which shows that life requires a lot of proofreading."

One of Those Things

Correspondence with organizations and individuals all over the world involving translations here and abroad sometimes has interesting repercussions. Not only the Society, but sometimes our address gets distorted, although one can understand a recent letter which instead of reading "1916 Race St." had us at "1916 Speed St." Perhaps one can understand this when translating. Also, one can appreciate how an error in printing changes things somewhat—to wit, a recent ASTM book which had us at 1916 Rice St. So it goes.

Application Volume of Refrigerating Data Book

The second revision of the Refrigerating Data Book, Applications Volume, first published in 1940 and revised in 1946, has just been issued as the 1950 edition by the American Society of Refrigerating Engineers. All chapters have been scrupulously reviewed, revised, and brought up to date by 81 authors, all recognized experts in their different fields. Several chapters have been completely rewritten to conform with the latest practice in refrigeration applications. In addition, the volume has been expanded to include five new chapters on subjects which have become of vital concern to the industry since 1946. These new chapters are: Packaging of Frozen Foods, Frozen Fruit Juice Concentrates, Storage of Dehydrated Fruits and Vegetables, Refrigeration of Fruits on Railroad Diners, and Metals for Use at Low Temperatures.

Extensive bibliographies are found throughout the book, providing sources of additional information for those interested in delving further into particular subjects. For locating subject matter in the book more easily, the index has been enlarged to include more headings, subheadings, and cross references.

The refrigeration industry's most complete Refrigeration Classified Directory will provide ready references for those seeking lists of suppliers and manufacturers of equipment, component parts, and materials. Every effort has been made to insure accuracy and completeness in this section as a service to readers.

The publication represents a tremendous amount of work on the part of the authors who were under the direction of D. C. McCoy, of Frigidaire, Editor-in-Chief. Copies of the book, which takes in 1080 pages, can be procured from the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18, N. Y., at $6 each.

Concrete Pipe Handbook

A compact handbook has been published by the American Concrete Pipe Association, combining a wealth of information. This publication was prepared by H. F. Peckworth, Managing Director of the Association. In concentrated form it presents experience records and data of the concrete pipe industry. It is prepared for users and producers of concrete pipe and contains engineering data and technical information cover[ing] the many phases of the manufactur[e] and laying of concrete pipe. After a bri[ef] introduction on the background of [the] industry and types of concrete pipe, th[ere] follows chapters dealing with manufactu[re], specifications and tests, and bedding a[nd] back-filling. The remainder of the bo[ok] contains chapters on engineering des[ign] and data, and information.

The appendix consists of reprints [of] ASTM and AASHO specifications cov[er]ing concrete pipe. Copies of this ha[nd]book are being made available to c[on]sumer engineers at a cost price of $4 [a] copy by the American Concrete P[ipe] Association, 228 North LaSalle St., C[hi]cago 1, Ill.

Certification of ASTM Reference Fuels

Committee D-2 on Pet[ro]leum Products and Lubricants, throu[gh] its Division on Combustion Characte[ris]tics, has issued a revised procedure [for] the certification of ASTM referen[ce] fuels used in the engine test methods [for] rating fuels. Copies of the proced[ure] have been placed in the hands of s[up]pliers and potential suppliers of s[uch] fuels as listed in the ASTM Manua[l on] Engine Test Methods for Rating Fu[els]. A limited number of copies of the p[ro]cedure are available at ASTM He[ad]quarters.

Handbook on Radiography

An informative and i[nter]esting manual on the use of radium [and] cobalt 60 in industrial radiography [has] been published by Eldorado Mining [and] Refining (1944) Limited, one of the [world's] prime producers of radium in the w[orld] and the only such firm on the N[orth] American Continent. Eldorado has b[een] given the exclusive rights for the distr[ibu]tion of the cobalt 60 produced at [the] Atomic Energy Project, Chalk R[iver], Can. The cobalt 60 obtained from [this] source is characterized by its high spe[cific] activity, resulting in a consequent [in]crease in the sensitivity of flaw detecti[on].

The manual provides a medium o[f in]troduction for those interested in [that] section of the field of industrial radio[gra]phy concerned with the use of the p[ene]trating radiation from naturally oc[cur]ring and artificially produced r[adio]active materials. Those already [em]ploying this type of radiation will find [the] collected data and charts a conve[nient] source of day-to-day reference. [For] those persons interested in exploring [the] field in greater detail, suggestions [for] further study have been included thro[ugh]out the text and in a selected bibliogra[phy].

The 72 pages of material includ[e] figures, 15 charts, and 6 tables. [The] manual may be obtained from Eldo[rado] Mining and Refining (1944) Lim[ited], P. O. Box 379, Ottawa, Canada, for $[...]

Casting of Brass and Bronze

A UNIQUE intermingling of technical facts and personal experience makes this book by Daniel R. Hull, Assistant Technical Manager, The American Brass Co., very interesting reading for anyone interested in the American brass industry. Practical aspects of brass and bronze casting in America from 1900 to 1950 are presented in an informal yet informative manner. Some of the foreword of the book gives an indication of its scope.

"This small volume is not, and makes no pretense of being, a review or compilation of literature on the subject of brass casting. It is, rather, a practical account of purely personal thoughts and experiences, the outgrowth of employment by The American Brass Co. If references to the work of others are scant, it is precisely for this reason. However, it would be impossible to write broadly about brass casting without reference to Genders and Bailey, whose book (Casting of Brass Ingots) still stands without a rival. Frequent reference to that work has been made, but much else that they said has undoubtedly been repeated herein. It could hardly be otherwise and should be put down as corroboration, not plagiarism.

"The same may be said for statements in any published work. The origin of ideas is seldom autogenetic or the growth of them autogenous. The source is often forgotten—still oftener unknown and unsuspected. The only justification anyone can claim for committing himself to paper is a belief that he has something to add to what has already been written; the same subject may be viewed from a slightly different angle or a conclusion arrived at by a different route. It is on this basis that the following opinions are offered."

Comprising 192 pages with many illustrations, this book is published by the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

The Condensed Chemical Dictionary

THIS fourth edition of the "Condensed Chemical Dictionary" has been completely revised, brought up to date, and enlarged with the addition of 1000 new items, making a total of over 13,000 items. Francis M. Turner was the Editorial Director of this Fourth Edition which was completely revised and enlarged by Arthur and Elizabeth Rose, State College, Pa.

The original 1919 volume was planned to serve the needs of people not formally educated along chemical lines. In each of the three succeeding editions, the editors have endeavored to ahere to the original objectives and to increase the contents of the book so as to cover completely all substances likely to be of commercial importance or scientifically "news worthy," and a long list of terms relatings to chemistry and the chemical industries which today confront the general public. A very valuable feature is the large number of chemical specialties, sold under trade marks or brand names, included in the present edition. Included are data on the chemical and physical properties of chemicals and raw materials. The information on containers, shipping regulations, and safety instructions has been continued and brought up to date. Many new items have been added in such fields as nuclear chemistry, chemotherapy, petrochemistry, etc. Many new cross references have been added to assist the reader in locating the wanted information and to clarify the confusion associated with chemicals and their synonyms.

This 726-page book is a helpful reference volume for all requiring quick access to essential data regarding chemicals and other substances used in manufacturing and research; and to terms in general use in chemistry and the process industries.

The Dictionary is published by Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y., and sells for $10.

British "Materials Engineer" Comments

THE British journal, *Roads and Road Construction*, has an interesting article entitled "New ASTM Standards" written by one who signs himself "Materials Engineer." Specifically this is a detailed review of Part 3 of the 1949 Book of ASTM Standards which deals with cement, concrete, ceramics, thermal insulation, road materials, waterproofing, and soils. The article is, however, much more than a book review because there is critical comment of certain individual specifications and groups of them, critical of development in Great Britain, and the writer does not laud the ASTM work at the exclusion of some suggestions. There are many references to the fact that our British friends had not done anything of this kind and should have. On the other hand, the writer takes ASTM to task for lack of clarity in certain illustrations and the fact that certain materials are not covered which if they were would be of service to certain industries.

We shall not resist the temptation to quote from the conclusion of the article which appeared in the October issue, in reference to this ASTM book.

"The indexing is of a high order and makes the volume very easy to use; in spite of the question of dollar exchange, this is one of the very few books that highway engineers simply cannot afford to be without; it is a real *vade mecum* of first-class information not obtainable in any other form. The production and general format is of the high standard which we expect of ASTM publications, and it is much easier to use than the small individual productions of the British Standards Institution. We prefer one respectably sized book for our office rather than a number of pamphlet-sized booklets more suited for the laboratory bench."

We are indebted to "Materials Engineer" for this article. It is being brought to the attention of some of our technical committee officers, for some of them will wish to consider the criticisms of our standards.

Voluntary Protection of Technical Information

ONCE again the dissemination of technical and scientific information has to be considered in the light of our national emergency. It is difficult to say what type of information can be published without materially helping the strategic intelligence efforts of our potential enemies. On the other hand, if the data are not made available, industrial and scientific developments in our country are slowed down considerably.

One remembers well the early days of World War II, when strict censorship was set up and editors of technical publications were required to submit galley proofs of almost all their material. But soon it was found out that this type of censorship was impossible to enforce since a lack of well-trained and qualified personnel could not evaluate specific technical and scientific papers for security violations. It was then that the system was changed to a voluntary censorship to be carried out exclusively by the editor of published materials. This system proved to be very satisfactory.

Recently the Interdepartmental Committee on Internal Security recommended the establishment of a service in the Department of Commerce which could advise state and local officials, representatives of private business, organizations and anyone interested on security questions arising with the publication of technical material. Secretary of Commerce Charles Sawyer, upon their recommendation, consulted with a group of technical and science editors on the details of such a plan, and it was then decided to establish this type of proposed service in the Office of Technical Services, headed by John C. Green.

Types of information which should be cleared for security reasons are technical data on advanced industrial developments, production "know-how," strategic equipment, special installations, and "significant integrations of previously scattered groups of information."

OTS has always been responsible for publishing unclassified technical information developed under Government-sponsored research and obtained from conquered enemy countries and it is sincerely hoped that the addition of this new service will be satisfactory, eliminating possible mandatory censorship.

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Metallurgical Advisory Board Members

Elsewhere in this BULLETIN is a news account of the formation of a National Metallurgical Advisory Board. A number of ASTM members and committee members are serving on this Board including the following: E. C. Bain, Zay Jeffries, A. B. Kinzel, William E. Mahin, Robert F. Mehl, Paul D. Merica, Albert J. Phillips, Earle C. Smith, J. G. Thompson, and Kent R. Van Horn.

At the recent 47th Annual Convention of the **American Concrete Institute** in San Francisco, a number of ASTM members active in the Society's cementitious and concrete committees were in the news. The retiring President, **Frank H. Jackson,** Principal Engineer of Tests, Bureau of Public Roads, Washington, D. C., is an Honorary ASTM member; and **A. T. Goldbeck,** Engineering Director, National Crushed Stone Assn., Washington, D. C., who continues as Senior Vice-President until 1952, is a long-time, active Society affiliate. **Henry L. Kennedy,** Manager of Cement Division, Dewey & Almy Chemical Co., Cambridge, Mass., was elected Vice-President of ACI for a two-year term. Elected among others to three-year terms as Directors on the Board of Direction were **G. L. Lindsay,** Director of Tests and Research, Universal Atlas Cement Co., New York, and **Walter H. Price,** Head, Materials Laboratory, Bureau of Reclamation, Denver, Colo. Among those honored by awards at the Convention were **Charles S. Whitney,** Partner in the firm of Ammann and Whitney, Consulting Engineers of Milwaukee and New York, who received the Alfred E. Lindau Award "in recognition of his many contributions to reinforced concrete design practice." **Harrison F. Gonnerman,** Assistant to the Vice-President for Research and Development, Portland Cement Assn., Chicago, and **Frank E. Richart,** Research Professor of Engineering Materials, University of Illinois, Urbana, were elected to ACI Honorary Membership. Prof. Richart is presently Vice-President of ASTM, and Mr. Gonnerman is a member of the Board of Directors of the Society.

E. O. Dixon, until recently Chief Metallurgical and Mechanical Engineer, Ladish Co., Cudahy, Wis., has been appointed Vice-President in Charge of Research and Metallurgy.

Enslo Smith Dixon, long-time member of the Society, and for many years affiliated with The Texas Company, Port Arthur, Tex., as Metallurgist, recently opened offices as Consultant in the same city.

W. F. Fair, Jr., Advisory Fellow at Mellon Institute, and Supervisor of the Koppers Co., Tar Products Div., Westfield, N. J., Laboratory, has been elected Chairman of the New York Metropolitan Section of the National Association of Corrosion Engineers for 1951.

John V. Freeman has opened consulting offices in Bellerose, L. I., N. Y. He was until recently Assistant to Vice-President, U. S. Steel Corp. of Delaware, New York City.

Glenn C. Friedly, formerly Manager, District Sales & Research Director, Lexington Supply Co., Cleveland, is now Vice-President, Sales, Twinsburg-Miller Corp., Twinsburg, Ohio.

Bruce W. Gonser, of Battelle Memorial Institute, has been appointed an Assistant Director of Battelle. Dr. Clyde Williams in making the announcement stated that Dr. Gonser will guide developments of Battelle's enlarged program in up-to-now unexplored fields of metallurgy and the chemistry of metals. A veteran member of the Battelle staff, he will continue also to direct much research in non-ferrous metallurgy. A graduate of Purdue in 1923, and later in metallurgy from Utah, receiving his doctorate in metallurgy at Harvard, Dr. Gonser is very active in the work of ASTM, currently serving as Chairman of the important Committee B-2 on Non-Ferrous Metals and Alloys, and is active in several subcommittees. He has written widely and has spoken at many national and local meetings including ASTM district affairs.

Harold C. Harris, formerly Metallurgist, Mack Manufacturing Corp., New Brunswick, N. J., is now Factory Metallurgist, International-Plainfield Motor Co., Plainfield, N. J.

John H. Holloman has been named Assistant Manager of the newly organized Metallurgy and Ceramics Divs. of General Electric's Research Laboratory, Schenectady, N. Y.

E. E. Kimmel has been appointed Technical Adviser for the Chemical Division of Koppers Co., Inc., Pittsburgh, Pa.

Benjamin J. Lazan, formerly on the faculty of the Department of Materials Engineering, Syracuse University, Syracuse, N. Y., is now Professor of Materials Engineering, University of Minnesota, Minneapolis.

Frank Leigner, Jr., has accepted a posi- tion as Production Supervisor, Charl- Pfizer & Co., Inc., Brooklyn, N. Y. H- was previously associated with the Ste- wart-Warner Corp., Indianapolis, Ind., a- Chemical Engineer.

Joseph Mazia, formerly Head, Prote- tive Finishes Section of the Pitman-Du- Laboratory, Frankford Arsenal, Phila- delphia, Pa., and subsequently Chief - Rust Proofing Division, American Chem- cal Paint Co., Ambler, Pa., recently en- tered business for himself as Consultin- Engineer, with offices at 1424 K St., N. W- Washington 5, D. C.

Bernard L. Mulcahy, President, Fu- Research Laboratory, Inc., Indianapoli- Ind., has become a member of the adviso- staff of The Foundry. An authori- on cupola operation and foundry coke, M- Mulcahy will assist the editors to answ- questions sent that publication concernin- these subjects.

The **Okonite Company** of Passaic, N. J- has announced the appointment of **E. I- Youmans** as Vice-President in Charge - Manufacturing and Research. Former- a Vice-President and Technical Direct- Mr. Youmans was for many years active - ASTM technical committee work, and - now participates in the activities of oth- technical groups.

Howard F. Peckworth, Managing Dire- tor, American Concrete Pipe Ass- Chicago, Ill, was named first Vice-Pre- dent of the Illinois Section, Americ- Society of Civil Engineers, at its rece- annual meeting. An active participant - ASTM technical work, Mr. Peckwor- has been Secretary of Committee C-13 - Concrete Pipe since 1946.

R. G. Pitts, formerly Supervisor of Qu- ity Control, Wabash Corp., Montoursvil- Pa., is now associated with Sylvania El- tric Products, Inc., of the same city, in - similar capacity.

John C. Redmond, until recently F- search Director of Kennametal, In- Latrobe, Pa., has been elected Vice-Pre- dent in Charge of Metallurgical Develo- ment.

C. G. A. Rosen, of the Caterpillar Tr- tor Co., Peoria, Ill., recently visited En- land, delivering at the invitation of t- Institution of Mechanical Engineers, - Clayton Lecture to the Automobile Di- sion, his subject being "Significant Cont- butions of the Diesel Research Labo- tory." Mr. Rosen has been very active - the work of ASTM Committee D-2 - Petroleum Products and Lubricants - many years, serving on its Advisory Co- mittee, as Chairman of Technical Co- mittee F on Diesel Fuels, and on oth- subgroups. At the request of the Soci- he conveyed a message of good will to - Institute of Petroleum in London fr- ASTM, at a special meeting of the Ins- tute's Standardization Committee.

Frank A. Rhame, formerly President - the Lunkenheimer Co., Cincinnati, a- for many years representative of - ASTM sustaining membership of t- company, has been succeeded by Paul - Arnall, who recently was Vice-Presid-

...l General Manager. Mr. Rhame will ...ntinue as a Director and in an advisory ...nsulting capacity.

Clarence C. Ruchhoft, Senior Sanitary ...gineer, Environmental Health Center, ...S. Public Health Service, Cincinnati, ...ently received the Second Annual ...ard of the Technical and Scientific ...ieties Council of Cincinnati, in recog...ion of outstanding achievements in his ...d. A member of many technical and ...entific groups, and a contributor to ...ny scientific publications, Mr. Ruch...ft has worked in the field of stream pol...ion, sewage disposal, and water purifica...n for the past thirty years. He is ...sently serving as a consultant to the ...gineering Division, Atomic Energy ...mmission, on its research and develop...nt program of waste disposal at Los ...amos National Laboratory.

Monte C. Throdahl has been appointed ...sistant Director of Research at the Rub...r Service Dept., Monsanto Chemical ..., Nitro, W. Va.

Fred J. Tobias has entered business for ...nself as Research Engineer in Allen...wn, Pa. He was formerly associated ...th the Hampden Brass & Aluminum ..., Springfield, Mass.

Westinghouse Electric Corp. has an...unced the appointment of R. S. Kersh, formerly Manager of Central Station Sales, as Manager of the Company's Steam Division at South Philadelphia, Pa. This appointment was announced by David W. R. Morgan, Vice-President in Charge of both the Steam and Aviation Gas Turbine Divisions.

J. L. Williams has been promoted to Director, Control and Inspection Laboratory, Styron Plastics Division, Dow Chemical Co., Midland, Mich.

Bureau of Standards Notes

Dr. Eugene C. Crittenden recently retired as Associate Director of the Bureau. He had been with the Bureau for 41 years and had been Associate Director since 1946.

Dr. Earl K. Fischer has been appointed Chief of the Organic Coatings Section of the Bureau, succeeding **Mr. E. F. Hickson** who retired last June after 31 years' service. This laboratory of the Bureau tests, analyzes, and investigates properties of paints, varnishes, and other protective coatings. **Mr. P. T. Howard** will continue as Assistant Chief of the section which was formerly known as the Paint, Varnish, and Lacquer Section.

...EW MEMBERS...

The following 86 members were elected from January 27, 1951, to March 13, 1951, making the total membership 6831 ... Welcome to ASTM

Note—Names are arranged alphabetically—company members first than individuals

...icago District

...ICAGO SCREW CO., THE, J. E. Tschopp, Metallurgist, 2701 Washington Blvd., Bellwood, Ill.
...RASSMAN, HERBERT S., Technical Consultant, 333 N. Oak Park Ave., Oak Park, Ill.
...ESCHKE, R. L., Director, Research Lab., Dynamatic Corp., Division of Eaton Manufacturing Co., 3307 Fourteenth Ave., Kenosha, Wis.
...ITTELMANN, EUGENE, Consulting Engineer, 549 W. Washington Ave., Chicago 6, Ill.
...OWER, WILLIAM R., Assistant Chief Chemist, Cities Service Oil Co., Technical Service Lab., East Chicago, Ind.
...OWERS, T. C., Manager, Basic Research, Portland Cement Assn., 33 W. Grand Ave., Chicago 10, Ill.
RABA, JOSEPH B., Chief Chemist, W. H. Barber Co., 3650 S. Homan Ave., Chicago 32, Ill.
RUSSELL, JOHN V., Laboratory Director, Republic Steel Corp., 116th and Burley Ave., Chicago 17, Ill.
WILLIAMS, RICHARD J., Assistant to Division Manager, American Hair and Felt Co., 1828 Merchandise Mart, Chicago 54, Ill. [J]*

Cleveland District

BARCZAK, ALEXANDER D., Plant Manager, Superior Foundry, Inc., 3542 E. Seventy-first St., Cleveland, Ohio.
BEAVER, WALLACE W., Assistant Director of Development, Brush Beryllium Col, Cleveland 3, Ohio.
COOPER, ROBERT B., Director of Research, United Cooperatives, Inc., 243 E. Main St., Alliance, Ohio. For mail: Box 305, Ithaca, N. Y.
MAILLIE, J. A., Specification and Claims Engineer, National Tube Co., Lorain Works, Lorain, Ohio.
MELVILLE, T., Technical Engineer, American Steel and Wire Co., Vibration Fatigue Lab., Cuyahoga Works, E. Forty-ninth St., Cuyahoga Heights, Ohio.

Detroit District

HARRIS, J. A., Chief Chemist, National Refining Co., Findlay, Ohio.
RACINE, ROBERT J., Technical Service, Wyandotte Chemicals Corp., Wyandotte, Mich.
REED, HERBERT C., Technical Director, Wolverine Finishes Corp., 836 Chicago Dr., S. W., Grand Rapids 9, Mich.
TWISS, SUMNER B., Head, Chemical Research Dept., Chrysler Corp., Engineering Div., Detroit, Mich.

New England District

FLOE, CARL F., Professor of Metallurgy and Consulting Metallurgist, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge 39, Mass.
HAMPSON, FRED W., President and Treasurer, Industrial Chromium Corp., 109 Lyman St., Holyoke, Mass.
MITCHELL, BYRON, Metallurgist, Smith & Wesson, Inc., 2100 Roosevelt Ave., Springfield, Mass.
SIMMS, JAMES K., Assistant Chief Engineer, United Fruit Co., 80 Federal St., Boston 10, Mass.

New York District

COMPANHIA SIDERURGICA NACIONAL, Heitor L. Correa, Attorney-in-Fact, Room 2513–15, 570 Lexington Ave., New York 22, N. Y.
IMPERIAL PAPER AND COLOR CORP., A. E. Van Wirt, Director of Research, Glens Falls, N. Y.
METAL AND THERMIT CORP., C. Kenneth Banks, Research Director, Box 471, Rahway, N. J.
REVERE CORPORATION OF AMERICA, INC., Edgar G. Grant, Production Superintendent of Precision Casting, 322 N. Cherry St., Wallingford, Conn.
SONOTONE CORP., Herbert Jenkins, Process Engineer, Box 200, Saw Mill River Rd., Elmsford, N. Y.
CHRISTIE, WILLIAM FRANK, Chief Chemist, Presto Plastic Products Co., Inc., 5410 Ave. U, Brooklyn, N. Y.
LEDFORD, RAYMOND F., Chemical Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J. For mail: 2920 Carroll Ave., Chicago 12, Ill.
MORRIS, FRED M., Development Engineer, Materials and Processes, American Airlines, Inc., La Guardia Field, New York, N. Y. For mail: 87-22 135th St., Richmond Hill 18, N. Y.
PAVARINI, GEORGE F., Vice-President, M. L. Oettel, Inc., 303 Pearl St., New York, N. Y. For mail: 126 Schraalenburg Rd., Haworth, N. J. [J]

...o the A.S.T. M. Committee on Membership, 1916 Race St., Philadelphia 3, Pa.

...entlemen:

Please send information on membership to the company or individual indicated below

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This company (or individual) is interested in the following subjects: (indicate field of activity, that is, petroleum, steel, non-ferrous, etc.,)

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Signed ________________

...ate________________ Address________________

Pepper, Eleanor, Designer, 150 E. Thirty-fifth St., New York, N. Y. For mail: 9 E. Ninety-sixth St., New York 28, N. Y.
Punshon, Thomas, Jr., Manager of Laboratories, J. M. Huber Corp., 620 Sixty-second St., Brooklyn 20, N. Y.
Reed, Kenneth D., Technical Representative, The De Laval Separator Co., 165 Broadway, New York 6, N. Y.
Selby, Harold E., Research Director, Bishop Manufacturing Corp., 10 Canfield Rd., Cedar Grove, N. J.
Stilley, Sydney H., Engineer, Lieb Brothers, Inc., 60 Park Pl., Newark, N. J. For mail: Hotel Robert Treat, Room 1127, Newark, N. J.
Thatcher, Raymond L., Director, Brooklyn Quality Control Labs., E. R. Squibb and Sons, 25 Columbia Heights, Brooklyn, N. Y.

Northern California District

Food Machinery and Chemical Corp., J. M. Hait, Vice-President and Director of Engineering, Central Engineering Dept., Coleman at Newhall Sts., San Jose, Calif.
Harrington, Robert W., Manager, Clay Brick and Tile Assn., Region 16A, Structural Clay Products Inst., 606 Sharon Bldg., 55 New Montgomery St., San Francisco 5, Calif.
Lee, Ralph E., Production Engineer, Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Moses, Harry M., Civil Engineer, U. S. Bureau of Reclamation, Box 928, Stockton, Calif. For mail: 10 W. Churchill, Stockton, Calif.
Offner, Walter W., President and Technical Director, X-Ray Engineering Co., 444 Market St., San Francisco 11, Calif.

Ohio Valley District

Black-Clawson Co., The, J. D. Sheley, Chief Metallurgist, Hamilton, Ohio.
McHugh, Mary P., Textile Technician, Fashion Frocks, Inc., 3301 Colerain Ave., Cincinnati 25, Ohio. [J]
Mendelson, Donald A., Engineer, Avco Manufacturing Co., Crosley Div., Cincinnati, Ohio. For mail: Box 971, Dayton 1, Ohio. [J]

Philadelphia District

Empire Steel Castings, Inc., E. A. Rodruan, Metallurgist, Box 139, Reading, Pa.
Lachman, Charles, Co., Inc., John F. Leahy, Chemist, Phoenixville, Pa.
United States Gasket Co., Teflon Products Div., M. A. Rudner, Chief Electronic Engineer, Box 93, Camden 1, N. J.
Applebaum, Samuel B., Manager, Cold Process Div., Cochrane Corp., Seventeenth St. and Allegheny Ave., Philadelphia 32, Pa. For mail: Meadowbrook, Pa.
Dailey, Edgar Glanding, Chief Manufacturing Engineer, International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.
Elder, John C., Assistant Manager, Robertson Manufacturing Co., Morrisville, Pa.
Hawkins, W. M., American Car and Foundry Co., Berwick 6, Pa.
Nelson, David A., Chemical Engineer, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. For mail: 1242 Riverside Dr., Kynlyn Apts., Wilmington, Del. [J]
Singleton, William F., Chemist, Fabrics and Finishes Dept., E. I. du Pont de Nemours and Co., Inc., 3500 Grays Ferry Rd., Philadelphia 46, Pa.

Pittsburgh District

Binder, William J., Manager, Engineering Service Dept., A. M. Byers Co., Box 1076, Pittsburgh 30, Pa.
Brezin, Martin, Chief Metallurgist, United States Steel Co., Metallurgical Dept., Homestead Works, Munhall, Pa.
Coleman, Gordon S., Supervisor of Quality Control, Wheeling Steel Corp., Yorkville, Ohio.
Martin, Clement D., Engineer, 6230 Penn Ave., Pittsburgh 6, Pa.

St. Louis District

Howard, Robert T., Chief Metallurgist, Black, Sivalls & Bryson, Inc., 7500 E. Twelfth, Kansas City 3, Mo.
Hurst, Vernon L., Specification Engineer, The Vendo Co., 7400 E. Twelfth, Kansas City 3, Mo.
Kinnick, Glen, Superintendent, Cooperative Refinery Assn., Box 570, Coffeyville, Kans.
Pollnow, Frank J., Jr., Technical Director, Vestal Chemical Laboratories, Inc., 4963 Manchester Ave., St. Louis 10, Mo.
Thumser, Robert C., Plant Engineer, Monsanto Chemical Co., St. Louis, Mo. For mail: 3939 Federer Pl., St. Louis 16, Mo.

Southern California District

Bechtel Corp., L. J. Blowers, Purchasing Agent, 3780 Wilshire Blvd., Los Angeles 5, Calif.
Herring, Ned B., Assistant Engineer, Holmes & Narver, 816 S. Figueroa St., Los Angeles 14, Calif. For mail: Box 994, Wilmington, N. C. [J]
Smull, L. C., Vice-President and Works Manager, Riverside Cement Co., 621 S. Hope St., Los Angeles 17, Calif.

Washington (D. C.) District

Bender, Edward W., Fire Prevention Engineer, National Bureau of Standards, Washington 25, D. C. For mail: 2315 Fortieth St., N. W., Washington 7, D. C.
Collett, Charles T., Physicist, U. S. Department of Commerce, National Bureau of Standards, Connecticut Ave. and Van Ness St., Washington 25, D. C. For mail: Route 4, Rockville, Md.
Hughes, John C., Physicist, National Bureau of Standards, Washington 25, D. C. For mail: 3021 Ferndale St., Kensington, Md.

Western New York-Ontario District

National Aniline Division, Allied Chemical and Dye Corp., Kelvin H. Ferber, Superintendent, Test and Inspecti[on] Dept., Box 975, Buffalo 5, N. Y.
Mitchell, Alfred B., Supervisor, Cont[r] Lab., E. I. du Pont de Nemours and C[o.], Inc., Niagara Falls, N. Y.

U. S. and Possessions

Lone Star Heat Treating Corp., L. J. V[an] Dorfy, President, 5212 Clinton Dr., Hou[s]ton 20, Tex.
Standard Cable Corp., James A. Pett[y] Jr., Chief Engineer, Chickasha, Okla.
McCauley, Edward Willette, Fire Dir[ec]tional Control, United States Mari[ne] Corps Reserve, First 155 mm Gun B[n.] FMF. For mail: 507 First North, A[pt.] 357, Seattle 9, Wash. [J]
U. S. Corps of Engineers, Department [of] the Army, District Engineer, Alaska D[is]trict, Anchorage, Alaska.
Utah State Agricultural College [Li]brary, Logan, Utah.

Other than U. S. Possessions

Compagnie des Saint Gobain, A. A. Riv[...] Lahousse, Ingenieur Chimiste, Serv. Tec[h]nico-Commercial, Dep. des Produits ([Or]ganiques, 1bis, place des Saussaies, Pa[ris] VIII[e], France.
Australia, Army Branch, Department [of] Supply, Controller, 339 Swantston S[t.] Melbourne C.1, Victoria, Australia.
Denina, Ernesto, Professor, Istituto [di] Elettrochimica Politecnico, Castello Valentino, Torino, Italy.
Janson, Jan-Erik, Executive Secreta[ry] Svenska Plast Foreningen (The Swed[ish] Plastics Federation), 43 Karlavag[en] Stockholm, Sweden.
Japanese National Railways, Seishi O[...]suka, Superintendent, Railway Techni[cal] Lab., No. 1, 1-chome, Marunouchi, Chi[yo]daku, Tokyo, Japan.
Noerhald, Henning, Chemical Engine[er] Cia. Nal. Productora de Cemento, Apt. [...] Managua, Nicaragua.
Provincial Library, W. E. Ireland, [Li]brarian and Archivist, Parliament Bld[gs.] Victoria, B. C., Canada.
Romero B, Francisco, Manager, Cemen[tos] Guadalajara, S. A., Apartado 14[...] Guadalajara, Jal., Mexico.
Sheffield City Libraries, City Librar[ian] Administration Dept., Central Libra[ry] Surrey St., Sheffield 1, England.
Travaux Publics Gt. Gl., du Congo Bel[ge] Laboratoire T. P. Gt. Gl., Leopoldv[ille] Kalina, Belgian Congo.

* [J] denotes Junior Member.

To the ASTM Committee on Membership

1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on membership in ASTM and include a membership application bla[nk].

Signed ______________________

Address______________________

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Date______________

NECROLOGY...

The Death of the following members has been reported

J. H. COURTNEY, American Standards Assn., Inc., stationed at the National Bureau of Standards, Washington, D. C. (March 8, 1951). Representative of the American Standards Assn. on Committee E-6 on Methods of Testing Building Constructions since the committee's organization in 1946, serving during the entire period as Secretary of this main group, also as a member of its Advisory Subcommittee.

ALFRED EWING, Managing Director, Climax Rock Drill and Engineering Works, Ltd., London, England. Representative of company membership since 1927.

J. W. FLEMING, Manager, Technical Information Center, Philips Laboratories, Inc., Irvington-on-Hudson, N. Y., died in an automobile accident, February 12, 1951, near his home in Edgewater, N. J. Member since 1950. Before joining Philips in 1946, Mr. Fleming was associated with the National Broadcasting Co. and the American Broadcasting Co. Widely known in the radio and television industry, he served overseas in World War II as technical adviser to the U. S. Air Force in Europe and the Royal Air Force, being attached during this period to the British Ministry of Aircraft Production.

E. D. HOLT, Head, Metallurgical Department, Precision Scientific Co., Chicago Ill. Representative of his company since August, 1949, on Committee E-4 on Metallography, and its Subcommittee on Selection and Preparation of Samples.

NATHAN LESTER, President, Lester Engineering Co., Cleveland, Ohio (June 10, 1950). Representative of company membership since 1944.

WILLIAM McDOWELL, Chief Engineer, Electro Metallurgical Division, Union Carbide and Carbon Corp., Niagara Falls, N. Y. (August 3, 1950). Representative of company membership since 1949.

FRANK A. RANDALL, Consulting Structural Engineer, Frank A. Randall and Sons, Chicago, Ill. (December, 1950). A member of the Society since 1921, Mr. Randall was serving on the Chicago District Council at the time of his death.

FRANK STUTZ, President, Better Fabrics Testing Bureau, New York, N. Y. (February 19, 1950). Representative of the Bureau's membership since 1935, also representative of the Bureau on Committee D-13 on Textile Materials for this entire period.

ERNEST OSGOOD SWEETSER, Professor of Civil Engineering, Washington University, St. Louis, Mo. (January 18, 1951). A member of ASTM since 1927, Professor Sweetser was affiliated also with a number of other professional and technical organizations including the American Railway Engineering Assn., the American Concrete Institute, and the American Society for Engineering Education. Joining the faculty of Washington University School of Engineering in 1905, his contribution to the growth of that institution spanned a period of somewhat more than 45 years.

J. HALL TAYLOR, President, Taylor Forge and Pipe Works (formerly American Spiral Pipe Works), Chicago, Ill. (February 13, 1951). Representative of company membership since 1923, and representative of his company on Committee A-1 on Steel from 1930 to 1947, serving on its Subcommittee IX on Steel Tubing and Pipe, and Subcommittee XXII on Valves, Fittings, Pipings and Flanges for High-Temperature and Subatmospheric Temperatures. In the latter Mr. Taylor was for many years Chairman of the Section on Forgings, and up until just a few years ago he found time from his many executive responsibilities to direct the work of this group.

A. Y. WILLIS, JR., U. S. Department of Agriculture, Cotton Branch, Production and Marketing Admin., Washington, D. C. (January 8, 1951). Representative of the Department of Agriculture since 1949 on Committee D-13 on Textile Materials and several of its subgroups.

FRED M. ZEDER, Vice-Chairman of the Board, Chrysler Corp., Detroit, Mich. (February 24, 1951). Member since 1917.

LABORATORY SUPPLIES...

Catalogs and Literature and Notes on New or Improved Apparatus

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

Di-Electric Constant Meter—Comprehensive literature on the Di-Electric Constant Meter is now available. This meter is an easy to operate instrument for measuring the dielectric constant of liquids and for demonstrating the principles related to this property. It is said to be the first simple, reliable instrument on the market for use in the relatively unexplored field. Information regarding procedure, accuracy, and description of the instrument is included.

Bulletin 280, Eberbach & Son Co., Ann Arbor, Mich.

Paint Testing Instruments—A complete 32-page catalog containing descriptions of the 75 items made or sold by the Gardner Laboratory, Inc., is now available. Equipment described falls under the following nine categories: viscosity; constant temperature baths; film thickness—film applicators; drying time; abrasion; hardness and adhesion; portable gloss and reflection meters; appearance and color; miscellaneous testing devices.

Henry A. Gardner Laboratory, Inc., Bethesda, Md.

General Laboratory Equipment—Vol. 1 No. 1 of a new house organ, *Labitems* has been published by the Emil Greiner Co. It features a catalog supplement of newly listed items which includes: balances, barometers, bell jars, centrifuges, clamps, colorimeters, ovens, and a number of other items of laboratory equipment. Of particular interest is an article entitled "Since 1880" which gives a brief history of the Greiner organization. Also included, is a crossword puzzle consisting primarily of technical terms.

The Emil Greiner Co., 20–26 Moore St., New York 13, N. Y.

pH Control and Water Tests—A new 12-page catalog (No. 600-10), entitled "Precise pH Control and Water Tests," illustrates and describes the Hellige Colorimetric Comparator line which ranges from the inexpensive Simplex Testers to the versatile Pocket and Standard Comparators, and the Aqua Tester. All models are equipped with color plates, or color disks, containing proved Non-Fading Glass Color Standards, and many new standards are now offered for the latest tests employed in analyses of water, sewage, and industrial waste. The catalog also introduces the Hellige Daylite Comparator Illuminator with which the popular Pocket and Standard Comparators can be used for determinations in both artificial and day light.

Hellige, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.

Manual for Dairy Testing—The fourth edition of the "Kimble Manual for Dairy Testing" has just been released by Kimble Glass, Div. of Owens-Illinois Glass Co. The 84-page manual contains complete, up-to-date information on the Babcock method of sampling and testing milk and milk products along with directions for twenty-four other tests and ten tables for reference to assist in performing these tests. The text is amplified by the liberal use of photographs and illustrations which, according to Kimble Glass, will greatly assist dairymen concerned with the testing of their products.

Kimble Glass, Div. of Owens-Illinois Glass Co., Box 1035, Toledo 1, Ohio.

Instrument Notes

Concrete Testing Machine—Redesigned to separate the loading and weighing units, a new concrete testing machine of 100,000-lb capacity is announced by Baldwin-Lima-Hamilton Corp. The two-unit design prevents transmission of load shocks to the indicator and keeps the operator out of range of flying or falling particles from breaking specimens. Welded construction of the loading unit and simple structural lines of both units have

greatly improved the appearance of the machine. The new testing machine is similar in operation to the 90,000-lb machine which it replaces. It is designed primarily for testing 2-in. cubes and 3 by 6-in. cylinders but the stroke and dimensions of the working space are large enough to permit many other uses.

Baldwin-Lima-Hamilton Corp., Paschall Station P. O., Philadelphia 42, Pa.

Industrial Baking Oven—A new type, small, gas-fired baking oven for industrial purposes is said to prove especially useful for (1) baking or tempering small production orders; (2) for heating samples, so that when large production orders are heated at the same temperature in large ovens, the results will be the same; and (3) for use in shops and laboratories for research, testing, precipitation hardening of beryllium-copper and other alloys, relieving hydrogen-embrittlement, drying cores, baking molds and plastics, and for many similar uses. Outside dimensions are 14 in. wide, 16 in. deep, and 20 in. high. The heating chamber is 10 in. wide, 9 in. high, and 12 in. deep with two shelves. Capacity is 250 to 650 F. Pyrometer actuated controller, 3-in. dial thermometer, two 60-min timers, 2 in. of insulation. Net weight 75 lbs.

The Carlson Co., 277 Broadway, New York, N. Y.

Melted Carbon Test—Carbon in mild steel baths is said to be determined in less than one minute by the Melters Carbon Test now available. Under the controlled conditions of the test, a hardness tester graduated in per cent carbon gives carbon results to within 0.02 per cent in the 0.05 to 0.45 per cent carbon range. The equipment is designed to give long service directly on the melting floor. Valuable furnace time may be saved by eliminating waiting time for laboratory preliminaries. The test may be applied to any nonaustenitic molten steel up to 0.60 per cent carbon.

Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich.

Self-Recording Accelerometer—Accelerometers described as completely self-contained recording instruments of rugged construction and simple in installation have been announced. Stated as features of the product are: Transducer and recording element are one unit, so no wires or telemetering equipment are required to connect one to the other; no electronic amplifiers or power supplies are required to record the acceleration; the only external connections are to an electrical or mechanical starting line; the acceleration of the instrument is recorded on magnetic tape driven by a spring motor; a tiny permanent magnet mounted on the seismic mass constitutes the recording element.

Engineering Research Associates, Inc., 1902 West Minnehaha Ave., St. Paul W4, Minn.

Laboratory Lifter—Easy positioning of heavy and/or hot laboratory equipment at various levels above the workbench is said to be afforded by use of an improved device manufactured by the Fisher Scientific Co. It has a platform which can be adjusted to any point from $1\frac{1}{2}$ to $18\frac{1}{2}$ in. above the workbench—merely by turning a screw-support to which the platform is attached. Heavy kettles, reaction flasks, cold and hot baths, and similar vessels are held safely on the device called the "Lab-Lift" or moved up or down so they can be attached or removed from reaction trains, etc.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Shuttle Tension Tester—The tension of yarns as they leave the shuttle during weaving is of importance to every textile mill. Faulty shuttle tension means defects in the filling. Stated as practically eliminating filling defects, a new shuttle tester is now available. The new test board gives a simple means of measuring and adjusting the tension while the yarn leaves the shuttle under an equivalent of performance condition. In operation, a shuttle with quill inside is put on a stand on the left side of the device. Yarn coming from it is threaded through the rollers of the tension meter. Then it is rewound on the axle of a special electric motor which has its stand on the right side. When the current is switched on, the yarn is pulled out of the shuttle and through the tension meter at the right speed.

Saxl Instrument Co., Harvard, Mass.

INSTRUMENT COMPANY NEWS ....

Announcements, changes in personnel, new plants and locations, and other notes of interest

Brush Development Co., 3405 Perkins Ave., Cleveland, Ohio. George M. Naimark has accepted a position with the hypersonic laboratory of the Brush Development Co., Cleveland, Ohio, having completed requirements for a Ph.D. at the University of Delaware.

Central Scientific Co., 1700 Irving Park Blvd., Chicago, Ill. W. A. Schlueter, President of Refinery Supply of Tulsa, Okla., and E. P. Holder, Chairman of Cenco Corp. and Central Scientific Co., announce the purchase of Refinery Supply by the Cenco Corp. The Refinery Supply Co. becomes a wholly owned subsidiary of the Cenco Corp. and will continue to operate as such. Mr. Schlueter will continue as president of Refinery Supply. He has also joined the Central Scientific Co. as a director and Vice-President.

Precision Scientific Co., 3737 W. Cortland St., Chicago, Ill. Arthur C. Cockett, formerly with H. Reeve Angel and Co., has joined the New York district office of Precision Scientific Co. as a technical sales representative.

Precision Scientific Co. Erwin Steffens has been appointed head of the Metallurgical Department, Precision Scientific Co., succeeding the late E. D. Holt. Mr. Steffen will be in charge of metallurgical investigation for all company divisions and manufacturing departments. Until recently he was associated with R. W. Hunt Co., Chicago, as metallurgist in charge of engineering.

ASA Approves Standard on Electrical Indicating Instruments

The American Standard Association has recently published th American Standard for Electrical Indicat ing Instruments designed as C 39.1—195 The development of this American Stand ard, approved January 4, 1951, has resulte from the work of the Sectional Commit tee on Electrical Measuring Instrument C39. It is a revision of the first America Standard on Electrical Indicating Instru ments, C39.1—1938, approved by th American Standards Association in Jul 1938.—In developing this revision, th committee has given due consideration the former American War Standard f Electrical Indicating Instruments, C39. 1944, and has incorporated those par which are applicable to instruments f use in peacetime industrial application It is available from ASA at a price of $1.6

The February, 1951, issue of "Standard zation," the news magazine of the Ame can Standards Association, Inc., contai an article relating how the Public Servi Electric and Gas Co. of New Jersey us this Standard.

Registration of Critical Instruments Suggest

The instrument manufa turers, through their trade association, t Scientific Apparatus Makers Associatio have suggested that certain special struments and apparatus, essential in ca of a disaster caused by atomic, chemic or biological attack, be registered a pooled so that their location can be i mediately known to the proper persons

Kenneth Andersen, Executive Vi President of the Association, mentio large centrifuges and incubators and c tain microscopes as typical of the essen instruments not readily available for in case of a disaster. He suggested th the Scientific Apparatus Makers Associ tion is the best-equipped and most log organization for registering such inst ments.

Symposium on Standardization of Spectrochemical Procedures

The Sixth Annual Meet of the Society for Applied Spectroscopy be held in New York will feature a Sy posium on Standardization of Spect chemical Procedures. Some 14 techni papers by various authorities will disc emission and absorption analysis. In ad tion to this symposium, which is schedu for Friday morning and afternoon, May in the Socony-Vacuum Training Cen 63 Park Row, there is to be a session applied spectroscopy and another on strumental developments on Saturd May 26. Further details of these sessi can be obtained from Mr. C. H. Nor National Lead Co. Titanium Divisi P. O. Box 58, South Amboy, N. J.

Outdoor Weather Aging of Plastics Under Various Climatological Conditions*[1]

By S. E. Yustein,[2] R. R. Winans,[2] and H. J. Stark[3]

Synopsis

The effects of outdoor weather aging under widely different climates are investigated for various types of plastic materials. Five climatological regions are represented in the program which provides for outdoor exposures on sites located in (1) Panama Canal Zone (tropical); (2) New Mexico (dry desert); (3) New York Naval Shipyard (temperate); (4) Fort Churchill, Manitoba, Canada (subarctic); and (5) Point Barrow, Alaska (arctic). The report covers exposures for 1, 3, 7, and 12 months. Subsequent reports will cover 18-, 24-, 30-, and 36-month exposures.

The materials dealt with in this report include 5 types of clear transparent sheet plastics, 6 types of laminated materials, and 5 types of molded terminal bars. The sheet materials are evaluated after each period of exposure for tensile and flexural properties, hardness, and dielectric constant and power factor. The electrical properties are determined for frequencies of 60, 1000, and 10^6 cycles. The transparent materials are evaluated also for light transmission and haze. The molded terminal bars are evaluated for insulation resistance, dielectric strength, and high-impact (HI) shock resistance.

On the basis of the extensive data accumulated at the completion of the first year's exposure, it is possible to deduce the occurrence of a variety of effects that appear to be related to differences in the climatic and environmental conditions and in the exposure periods.

Although many data n the resistance of plastics to natural nd accelerated weathering have been ccumulated, the resistance of plastic naterials to outdoor weather aging uner different climatic conditions has een investigated to only a very limited xtent. Data showing the effects of exosure to weather in Florida (subtropial) and Massachusetts (cool, temperte) on cellulose acetate and cellulose itrate sheet plastics, and indicating hat exposure in Florida is more damagng than exposure in Massachusetts have een made available.[4] A more recent nvestigation, reported by Long,[5] involved exposures of various thermoplasics (cellulose derivatives) and laminates n Florida and Dayton, Ohio. Because here is a recognized need for research and development of materials essential for military operations in tropical and arctic areas as well as in other regions, it was desired to investigate the weathering action of several different climates. For this reason, the authors are conducting an investigation based upon a joint program by the Bureau of Ships, U. S. Navy, and the Bureau of Ordnance, U. S. Army.

The present report summarizes a part of the investigation and deals with those materials which are included in the Bureau of Ships program and which have been subjected to outdoor exposures for various periods up to 12 months. For simplification this report is divided into 3 parts:

Part I.—Exposure Stations
Part II.—Weather Aging Program on Sheet Plastics
Part III.—Weather Aging Program on Molded Terminal Blocks

Part I. Exposure Stations

The following exposure stations are represented in the Bureau of Ships Weather Aging Program:

1. Tropical Exposure Station, Panama Canal Zone (9 deg., North Latitude)
2. White Sands Proving Ground, New Mexico (32 deg., North Latitude)
3. New York Naval Shipyard, New York (41 deg., North Latitude)
4. First Arctic Test Detachment, Fort Churchill, Canada (59 deg., North Latitude)
5. U. S. Naval Arctic Test Station, Point Barrow, Alaska (71 deg., North Latitude)

These stations represent a range of climates. As a result, the materials are subjected to environments characterized by comparatively extreme conditions of temperature, moisture, wind, sun, and other meteorological factors.

Weather data furnished by each of the exposure stations and covering the 12 months' exposure period are presented graphically in Fig. 2. In addition to being characterized by fluctuations in these specific elements, each of the environments represented by the individual exposure station may be characterized by many other complex factors, some of which are peculiar to the particular climate and others which are influenced by local conditions.

Panama:

The climate prevailing at the Tropical Exposure Station operated by the Naval Research Laboratory at Fort Sherman in the Panama Canal Zone is representative of warm humid tropical conditions. The Canal Zone area is characterized by 2 seasons, a wet season, about 8 months in duration, extending approximately from April into December, and a dry season. Somewhat more than 90 per cent of the annual rainfall is concentrated in the wet season. The total rainfall reported at the exposure site for the full exposure year was 114.6 in. The region is also characterized by high absolute as well as high relative humidity and uniformly high temperatures. In addition, the climate of equatorial regions is characterized by intense sunlight producing strong ultraviolet radiation.

New Mexico:

The climate prevailing at White Sands Proving Ground in Las Cruces, N. M., is representative of hot, dry desert conditions. The exposure site is located in a semi-arid region which is characterized by marked diurnal ranges of temperature, comparatively little rain, clouds, or fogs, few general storms, mild climate during the cold season, and abundant intense sunshine, which

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NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at the Fifty-third Annual Meeting of the Society, June 26–30, 1950.

[1] The opinions or assertions contained herein are those of the authors and are not to be construed as reflecting the views of the Department of the Navy or the Naval Service at large.

[2] Plastics Technologist and Materials Engineer, respectively, Material Laboratory, New York Naval Shipyard, Brooklyn, N. Y.

[3] Bureau of Ships, Department of the Navy, Washington, D. C.

[4] T. S. Carswell and H. K. Nason, "Effect of Environmental Conditions on the Mechanical Properties of Organic Plastics," Symposium on Plastics, pp. 22–26, Philadelphia District Meeting, Am. Soc. Testing Mats. (1944). (Symposium issued as separate publication, *STP No. 59.*)

[5] J. K. Long, "Effect of Outdoor Exposure on Plastics," *Modern Plastics*, Vol. 27, No. 3, November, 1949, pp. 109–110.

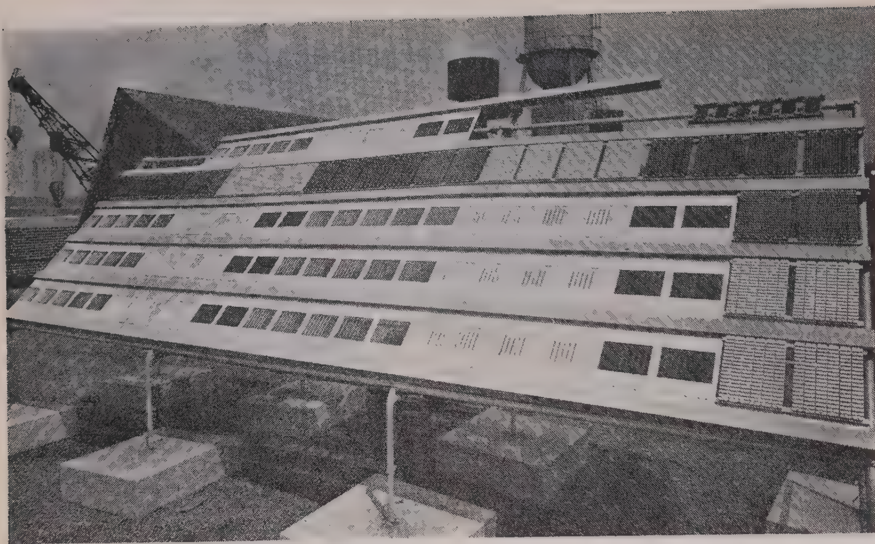

Fig. 1.—Specimens Mounted on Exposure Racks at New York Naval Shipyard Exposure Station.

produces strong ultraviolet radiation.

New York:

The climate prevailing at the New York Naval Shipyard, Brooklyn, N. Y., is representative of temperate conditions and is generally classified as a "warm, humid climate of the middle latitudes." The chief distinguishing factors are (1) the rapid, irregular, extreme weather changes; (2) strongly contrasting seasons; and (3) large annual range of temperatures. The region, as a whole, is characterized by moderate rainfall, humidity, and sunshine. However, the New York Naval Shipyard is located in an industrial and manufacturing center, and as a consequence, atmospheric conditions at this exposure site are characterized by severe contamination with smoke, dust, and industrial gases. For some of the materials, this contamination represents an important environmental factor in accelerating deterioration.

Canada:

The climate prevailing at Fort Churchill, Canada, is representative of the "cold, humid conditions" of the middle latitudes, and is generally classified as subarctic. The chief climatic factor is the extremely large range of average temperatures occurring over the year. For the exposure year, this range was from −38 F. to 79 F. Other factors are the heavy snow and the occasional occurrence of ice fogs, snow fogs, and falling ice crystals.

Alaska:

The climate prevailing at the U. S. Naval Arctic Test Station, Point Barrow, Alaska, is representative of conditions in the polar regions, and is generally classified as tundra or arctic. The chief climatic factors are extreme cold, heavy snowdrifts, and severe winds. During all of the first 7 months of the exposure period, the temperature remained below zero, and for an appreciable portion of the time was as low as −50 F. Snow falls to depths of perhaps 4 ft. or so, and is packed by the high winds into solid drifts; yet the total precipitation is very small.

Part II. Weather Aging Program on Sheet Plastics Materials

Materials Selected:

Transparent Plastic Sheets.—These consist of sheets, $\frac{1}{8}$ in. in nominal thickness, from which the required specimens were cut and prepared. All the materials selected are general purpose types available in standard commercial grades. The types included are as follows:

1. Methyl methacrylate, cast.
2. Cellulose acetate, slight yellow cast. Chemical analysis showed a plasticizer content of 20 per cent consisting of tricresyl phosphate and phthalate esters.
3. Allyl resin, cast.
4. Vinyl copolymer, bluish cast. Chemical analysis showed a vinyl chloride content of 83 per cent.
5. Cast phenolic, slight yellow cast, acetone soluble matter content of 14 per cent when received.

Low-Pressure Glass Laminates.—These consist of $\frac{3}{32}$-in. sheets, white in color with a gray-green cast, and were manufactured for this investigation. The types included are:

6. Styrene maleate polyester, glass base. Sheet filler consists of 9 plies of Fiberglas cloth No. 162, parallel laminated.
7. Styrene phthalate polyester, glass base. Sheet filler of 9 plies of Fiberglas cloth No. 164, parallel laminated.

Silicone, Phenolic, and Melamine Laminated Materials.—These consist of $\frac{1}{8}$-in. sheets; all the materials are of standard commercial grades. The types included are:

8. Melamine-formaldehyde glass base, mottled brown color, sheet filler of 20 plies of Fiberglas cloth No. 128, cross laminated, Navy Type GMG.
9. Silicone, glass base, light brown or tan in color sheet filler of 8 plies of Fiberglas cloth No. 261, parallel laminated, Navy Type GSG.
10. Phenol-formaldehyde paper base, black, standard grade XX, Navy Type PBG.
11. Phenol-formaldehyde, fabric base, black, grade CE, Navy Type FBG.

Periods and Methods of Exposure:

Outdoor exposures are made on racks located at the various exposure sites and set up to face true south. The specimens are mounted on aluminum panels with the panels fastened to the racks at a 45-deg. angle of inclination. Figure 1 shows the exposure racks and mounted specimens at the New York Naval Shipyard exposure site.

Each of the exposure panels for the sheet materials contains (*a*) six tension bars cut from the sheet materials and machined to standard design and dimensions and (*b*) one flat strip, 8½ by 2 in. The program provides for exposures of 1, 3, 7, 12, 18, 24, and 30 months at Panama and New Mexico; and 3, 7, 12, 18, 24, 30, and 36 months at New York, Canada, and Alaska. The differences in the exposure periods were provided for at the inception of the program because the tropical climate at Panama and the hot, dry desert climate at New Mexico were believed to provide more severe exposure conditions than those provided at the other stations.

The panels are removed at the completion of their scheduled exposures and returned to the Material Laboratory where they are conditioned for at least 14 days at 25 C. and 50 per cent relative humidity before testing.

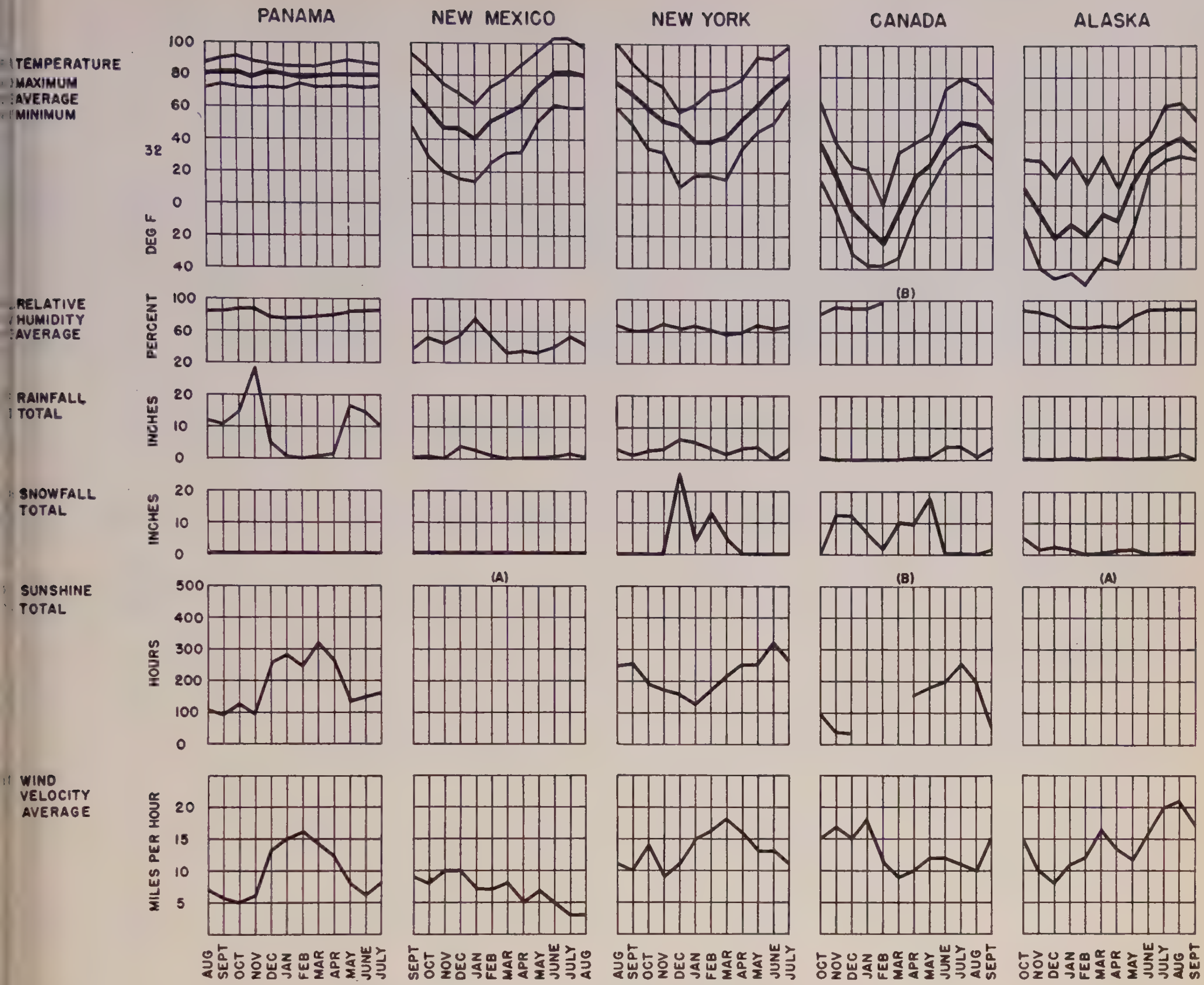

Fig. 2—Weather Data During 12-Month Exposure Period.

NOTE: (A) data not furnished, (B) data incomplete.

Tests and Test Methods:

The transparent sheet plastics are tested for tensile strength, tensile modulus, flexural strength, hardness, dielectric constant, and power factor (at 60, 1000, and 10^6 cycles), and light transmission and haze.

Tensile Properties.—Determinations are made in accordance with A.S.T.M. Method D 638.[6] Six tension specimens are exposed for each material at each exposure station and for each exposure period. The average of the determinations on six specimens is reported as the tensile strength.

Flexural Strength.—Determinations are made in accordance with A.S.T.M. Method D 790.[7] Three specimens, 4 by ½ in., are cut from the weather-exposed portion of each 8½ by 2-in. strip, after the completion of the electrical and optical tests described below. Direction of loading is flatwise; span length is 2 in.; rate of head travel is 0.25 in. per min. The average of the determinations made is reported as the flexural strength.

Dielectric Constant and Power Factor.—Determinations are made in accordance with A.S.T.M. Method D 150.[8] Electrodes consist of metal foil, each 4 by 2 in. applied to both sides of the weather exposed portion of the 8½ by 2-in. strip. A General Radio Co., 716 C bridge is employed, and one determination is made for each of the following frequencies: 60, 1000, and 10^6 cycles per sec.

Light Transmission and Haze.—Determinations are made in accordance with the A.S.T.M. Method D 1003.[9] A General Electric recording spectrophotometer is employed for the measurement, and the method outlined under Procedure B of the indicated method is followed. One determination is made on the exposed portion of each 8½ by 2-in. strip.

Hardness.—Determinations are made in accordance with the A.S.T.M. Method D 785.[10] Determinations are made on the exposed portion of each 8½ by 2-in. strip prior to cutting the flexural strength test specimens. Each reading is made on a spot that would fall within the overhang area of the flexure speci-

[6] Tentative Method of Test for Tensile Properties of Plastics (D 638 – 49 T), 1949 Book of ASTM Standards, Part 6, p. 585.

[7] Tentative Method of Test for Flexural Strength of Plastics (D 790 – 49 T), 1949 Book of A.S.T.M. Standards, Part 6, p. 119.

[8] Tentative Method of Test for Power Factor and Dielectric Constant of Electrical Insulating Materials (D 150 – 47 T), 1949 Book of A.S.T.M. Standards, Part 6, p. 419.

[9] Tentative Method of Test for Haze and Luminous Transmittance of Transparent Plastics (D 1003 – 49 T), 1949 Book of A.S.T.M. Standards, Part 6, p. 666.

[10] Tentative Method of Test for Rockwell Hardness of Plastics and Electrical Insulating Materials (D 785 – 48 T), 1949 Book of A.S.T.M. Standards, Part 6, p. 124.

TABLE I.—PROPERTIES OF CLEAR TRANSPARENT PLASTIC

	Aging Period, months	Methyl methacrylate					Cellulose Acetate				
		Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
Tensile strength, psi	0	...	...	8300	...	...	...	...	5800	...	...
	1	8600	8600	...	...	...	4700	4800	...	...	...
	3	8600	8800	8600	7500	6200	4800	5500	4800	5000	5000
	7	8600	8300	7100	7100	6200	4600	4800	4640	4800	4500
	12	8100	8700	7600	8500	7500	4900	5000	4400	5200	4600
Tensile modulus, $\times 10^6$ psi	0	...	...	0.37	...	...	...	...	0.25	...	...
	1	0.38	0.40	...	...	...	[b]	0.28	...	...	...
	3	0.36	0.35	0.37	0.33	0.33	0.21	0.28	0.21	0.23	0.21
	7	0.34	0.34	0.28	0.32	0.33	0.21	0.27	0.24	0.24	0.2[illegible]
	12	0.36	0.40	0.35	0.39	0.34	0.19	0.28	0.23	0.27	0.19
Flexural strength, psi	0	...	...	14 800	...	...	...	...	9000	...	...
	1	14 000	12 700	...	...	...	9 700	8700	...	...	...
	3	13 200	14 800	10 200	13 700	15 340	10 400	9700	9700	9000	8800
	7	11 500	14 800	13 300	14 000	14 200	10 200	8700	9300	8600	8800
	12	12 700	12 100	9 900	14 100	14 000	10 100	9200	8900	9600	9100
Rockwell hardness, avg	0	...	...	M85	...	...	...	...	L66	...	...
	1	M88	M90	...	...	...	L51	L61	...	...	...
	3	M88	M88	M89	M89	M88	L54	L62	L60	L62	L6[illegible]
	7	M91	M91	M86	M88	M85	L52	L57	L53	L47	L5[illegible]
	12	M91	M91	M88	M90	M88	L45	L56	L56	L61	L5[illegible]
Dielectric constant (60 cycles)	0	...	...	3.61	...	...	...	...	5.35	...	...
	1	3.61	3.50	...	...	...	5.84	5.72	...	...	...
	3	3.59	3.52	3.55	3.55	3.48	5.44	5.51	5.74	5.38	5.3[illegible]
	7	3.53	3.40	3.56	3.49	3.48	5.52	5.59	5.59	5.72	5.6[illegible]
	12	3.47	3.59	3.53	3.50	3.49	5.37	6.01	5.66	5.67	5.7[illegible]
Dielectric constant (10^3 cycles)	0	...	...	3.23	...	...	...	...	5.17	...	...
	1	3.28	3.17	...	...	...	5.66	5.54	...	...	...
	3	3.24	3.18	3.23	3.20	3.17	5.27	5.34	5.58	5.21	5.1[illegible]
	7	3.21	3.11	3.21	3.15	3.18	5.35	5.42	5.41	5.51	5.5[illegible]
	12	3.18	3.25	3.16	3.20	3.12	5.22	5.83	5.46	5.54	5.4[illegible]
Dielectric constant (10^6 cycles)	0	...	...	2.76	...	...	...	...	4.27	...	...
	1	2.83	2.77	...	...	...	4.72	5.21	...	...	...
	3	2.81	2.80	3.08	2.80	2.37	4.41	4.42	4.70	4.31	4.2[illegible]
	7	2.82	2.75	2.81	2.76	2.79	4.43	4.47	4.48	4.57	4.5[illegible]
	12	2.72	2.93	2.77	2.78	2.73	4.39	4.93	4.51	4.66	4.6[illegible]
Power factor (60 cycles)	0	...	...	0.072	...	...	...	...	0.015	...	...
	1	0.068	0.066	...	...	...	0.016	0.015	...	...	...
	3	0.066	0.066	0.067	0.067	0.065	0.021	0.014	0.017	0.016	0.0[illegible]
	7	0.065	0.064	0.070	0.066	0.067	0.018	0.016	0.017	0.017	0.0[illegible]
	12	0.072	0.066	0.090	0.066	0.066	0.022	0.017	0.023	0.016	0.0[illegible]
Power factor (10^3 cycles)	0	...	...	0.048	...	...	...	...	0.023	...	...
	1	0.048	0.047	...	...	...	0.023	0.024	...	...	...
	3	0.049	0.047	0.047	0.047	0.047	0.023	0.023	0.024	0.024	0.0[illegible]
	7	0.045	0.045	0.049	0.046	0.047	0.026	0.025	0.024	0.024	0.0[illegible]
	12	0.045	0.048	0.046	0.053	0.045	0.025	0.024	0.024	0.027	0.0[illegible]
Power factor (10^6 cycles)	0	...	...	0.022	...	...	...	...	0.068	...	...
	1	0.023	0.020	...	...	...	0.065	0.058	...	...	...
	3	0.023	0.020	0.020	0.022	0.022	0.058	0.065	0.065	0.070	0.0[illegible]
	7	0.023	0.021	0.021	0.022	0.021	0.063	0.067	0.068	0.067	0.0[illegible]
	12	0.022	0.022	0.021	0.025	0.022	0.062	0.068	0.071	0.069	0.0[illegible]
Light transmission, per cent	0	...	...	92.0	...	...	...	...	87.6	...	...
	1	92.7	93.0	...	...	...	89.5	89.7	...	...	...
	3	91.6	91.2	92.5	92.3	92.1	85.8	88.4	88.3	87.6	87[illegible]
	7	92.2	92.7	92.4	91.8	92.4	88.5	89.4	80.1	87.7	86[illegible]
	12	91.3	91.6	90.9	92.2	92.2	88.5	88.8	67.0	88.8	87[illegible]
Haze, per cent	0	...	...	0.0	...	...	...	...	1.4	...	...
	1	0.2	0.0	...	...	...	1.5	2.9	...	...	...
	3	0.4	1.3	0.6	1.2	1.1	4.1	3.2	5.7	4.2	2[illegible]
	7	0.5	1.1	5.1	1.7	0.6	3.8	2.8	18.2	6.0	8[illegible]
	12	1.6	1.7	3.3	1.2	1.5	4.6	4.0	60.8	4.3	7[illegible]
Color, surface and warpage effects		Negligible effects in all samples except for slight yellowing of New Mexico 12-mo. samples.					Samples showed warpage varying with exposure station and period; Panama samples showed greatest warpage. New York samples showed increased haziness, and after 12 months exposure, severe crazing.				

[a] Data reported for 7-mo. Canada samples were actually obtained for samples mistakenly removed after 6-mo. exposure.
[b] Load Deflection Data not obtained.
[c] Samples almost completely opaque.

MATERIALS BEFORE AND AFTER OUTDOOR WEATHER AGING.[a]

Allyl Resin					Vinyl Copolymer					Cast Phenolic				
Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
...	...	4100	...	...	...	...	10 200	...	...	...	...	9500	...	...
4300	4500	...	...	...	10 000	10 100	...	...	...	5200	3300	...	...	...
3700	4700	3900	3800	4400	10 000	10 100	10 200	9200	9 800	3500	3700	2300	7300	8000
4200	4400	4700	3600	3900	9 800	8 500	7 900	8400	9 800	6300	3400	1400	8100	8000
4000	4100	4700	4000	4200	9 700	9 500	9 400	9800	10 000	4300	2000	2400	6900	7200
...	...	0.29	...	...	...	...	0.47	...	...	...	...	0.54	...	...
0.33	0.36	...	...	...	0.49	0.49	...	...	...	[b]	[b]	...	...	...
0.33	0.33	0.35	0.29	0.32	0.45	0.48	0.46	0.44	0.46	0.21	0.62	0.57	0.42	0.50
0.35	0.35	0.31	0.30	0.32	0.42	0.41	0.40	0.39	0.45	0.38	0.66	0.45	0.52	0.51
0.35	0.38	0.33	0.35	0.35	0.44	0.45	0.42	0.45	0.46	0.29	0.70	0.49	0.57	0.51
...	...	13 100	...	...	...	...	17 500	...	...	...	...	23 000	...	...
11 500	10 700	...	...	...	17 600	17 500	...	...	...	11 400	17 200	...	...	...
11 100	10 100	10 800	12 900	12 400	17 500	17 900	17 100	17 600	17 200	12 700	11 100	12 600	15 100	13 500
11 600	12 400	12 700	12 400	6 800	16 400	17 300	17 200	17 300	17 600	13 000	15 200	8 800	14 600	13 800
11 300	12 800	10 900	13 500	9 000	15 400	14 600	17 800	17 600	17 800	9 000	11 400	8 100	13 000	11 400
...	...	M89	...	...	...	...	M72	...	...	...	...	M118	...	...
M86	M88	...	...	...	M71	M71	...	...	...	M101	M116	...	...	...
M87	M88	M88	M84	M85	M71	M70	M71	M70	M68	M92	M116	M114	M106	M115
M87	M88	M86	M85	M85	M71	M69	M69	M66	M69	M107	M116	M113	M114	M115
M84	M86	M88	M87	M86	M72	M73	M71	M69	M70	M112	M120	M115	M115	M113
...	...	4.22	...	...	...	...	3.12	...	...	...	...	7.42	...	...
4.45	4.23	...	...	...	3.12	3.12	...	...	...	11.66	7.08	...	...	...
4.40	4.22	4.36	4.31	4.10	3.09	3.11	3.07	3.07	3.05	13.46	7.04	6.98	7.19	6.82
4.48	4.21	4.35	4.25	4.41	3.10	3.05	3.08	3.05	3.19	8.63	6.77	7.46	7.24	7.19
4.64	4.63	4.26	4.31	4.29	3.08	3.09	2.54	3.03	3.10	11.52	6.22	6.85	7.43	7.61
...	...	4.14	...	...	...	...	3.08	...	...	...	...	6.57	...	...
4.39	4.16	...	...	...	3.08	3.08	...	...	...	8.84	6.35	...	...	...
4.33	4.16	4.31	4.22	3.95	3.05	3.08	3.04	3.05	3.04	9.50	6.27	6.31	6.37	6.12
4.42	4.14	4.27	4.17	4.33	3.08	3.01	3.04	3.02	3.16	7.24	6.18	6.48	6.39	6.34
4.56	4.55	4.21	4.30	4.19	3.04	3.06	2.51	3.06	3.04	8.21	5.78	6.13	6.54	6.52
...	...	3.57	...	...	...	...	2.55	...	...	...	...	5.22	...	...
3.75	3.58	...	...	...	2.85	2.85	...	...	...	5.82	5.02	...	...	...
3.69	3.60	3.90	3.64	3.54	2.83	2.84	3.07	2.83	2.79	5.02	4.95	5.19	5.00	4.86
3.74	3.55	3.64	3.60	3.76	2.85	2.80	2.81	2.80	2.95	5.34	4.99	5.07	5.03	5.03
3.85	3.95	3.59	3.76	3.69	2.76	2.93	2.42	2.93	2.91	5.54	4.82	4.88	5.21	5.15
...	...	0.012	...	...	...	...	0.009	...	...	...	...	0.103	...	...
0.013	0.013	...	...	...	0.007	0.007	...	...	...	0.279	0.089	...	...	...
0.010	0.009	0.011	0.011	0.010	0.007	0.006	0.007	0.008	0.007	0.337	0.090	0.090	0.095	0.085
0.010	0.013	0.011	0.010	0.010	0.007	0.007	0.008	0.008	0.007	0.149	0.072	0.112	0.094	0.092
0.010	0.010	0.010	0.010	0.010	0.008	0.009	0.008	0.007	0.007	0.273	0.057	0.128	0.105	0.118
...	...	0.013	...	...	...	...	0.010	...	...	...	...	0.057	...	...
0.014	0.012	...	...	...	0.010	0.010	...	...	...	0.140	0.054	...	...	...
0.013	0.012	0.013	0.013	0.017	0.010	0.010	0.010	0.010	0.010	0.164	0.056	0.055	0.059	0.053
0.014	0.013	0.013	0.013	0.014	0.011	0.011	0.010	0.011	0.010	0.085	0.049	0.062	0.057	0.057
0.014	0.014	0.013	0.013	0.013	0.010	0.011	0.009	0.010	0.010	0.129	0.042	0.054	0.061	0.066
...	...	0.063	...	...	...	...	0.019	...	...	...	...	0.062	...	...
0.067	0.061	...	...	...	0.017	0.016	...	...	...	0.087	0.060	...	...	...
0.067	0.062	0.056	0.073	0.059	0.018	0.016	0.015	0.017	0.019	0.086	0.058	0.053	0.060	0.057
0.071	0.064	0.068	0.062	0.066	0.016	0.016	0.014	0.016	0.017	0.065	0.056	0.066	0.059	0.064
0.070	0.067	0.071	0.067	0.063	0.017	0.018	0.023	0.020	0.021	0.077	0.052	0.067	0.063	0.061
...	...	91.8	...	...	...	...	74.2	...	...	...	...	84.8	...	...
92.6	92.3	...	...	...	75.0	75.4	...	...	...	84.4	85.6	...	...	...
90.6	90.6	91.9	91.6	92.0	73.7	74.7	74.9	74.6	74.7	82.2	84.9	77.4	83.6	84.7
91.6	91.5	90.0	91.7	91.7	50.6	62.4	74.9	74.3	74.8	82.3	85.3	72.3	84.8	84.7
91.1	91.2	90.0	91.7	91.4	49.1	1.2	71.2	74.8	75.0	74.6	84.8	52.6	84.0	80.0
...	...	0.0	...	...	...	...	1.7	...	...	...	...	0.0	...	...
0.0	0.0	...	...	...	1.6	1.9	...	...	...	0.8	0.9	...	...	...
1.6	0.8	0.0	0.3	0.5	4.4	2.4	2.3	4.7	2.8	4.3	1.3	10.9	2.0	0.7
0.5	0.7	1.6	0.3	1.0	3.8	6.7	4.3	3.2	2.9	4.0	3.0	31.0	1.7	1.7
0.6	1.1	2.2	0.4	0.7	14.2	[c]	4.7	2.4	3.7	6.6	2.7	75.1	1.4	4.1
Negligible effects.					7- and 12-mo. samples exposed in Panama and New Mexico showed severe discoloration; 12-mo. New Mexico samples almost completely opaque. 12-mo. New York samples slightly discolored.					Samples discolored to a brownish yellow after all exposures, the degree of discoloration varying with exposure station and period. New York samples showed extremely severe discoloration and crazing. Panama samples warped.				

TABLE II.—PROPERTIES OF LOW-PRESSURE GLASS LAMINATES BEFORE AND AFTER OUTDOOR WEATHER AGING.[a]

	Aging Period, months	Styrene Maleate Polyester, Glass Base					Styrene Phthalate Polyester, Glass Base				
		Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
Tensile strength, psi.	0	...	...	31 400	...	...	...	...	31 800	...	...
	1	31 600	34 400	...	...	...	30 100	33 200	...	...	...
	3	31 400	33 900	32 600	31 900	32 300	32 000	32 000	31 000	30 400	32 400
	7	27 000	30 800	27 400	28 700	30 300	30 200	30 200	27 700	29 800	31 200
	12	26 400	29 400	27 800	27 300	28 300	29 500	31 500	30 000	29 600	29 200
Tensile modulus, psi. × 10^6	0	...	...	1.98	...	...	...	...	2.33	...	...
	1	2.12	2.15	...	...	...	2.02	2.22	...	...	...
	3	2.18	2.42	2.20	1.97	1.86	1.98	2.09	2.08	1.91	2.01
	7	1.83	2.17	1.81	1.65	1.79	1.83	1.90	1.79	1.62	1.93
	12	1.96	2.21	2.02	1.75	1.66	1.64	1.86	1.82	1.58	1.64
Flexural strength, psi.	0	...	...	35 100	...	...	...	...	38 800	...	...
	1	38 300	41 200	...	...	...	36 700	38 200	...	...	...
	3	36 900	39 900	38 600	32 700	33 500	32 400	40 900	34 800	39 800	39 800
	7	34 300	36 800	35 600	34 200	35 300	33 800	37 300	32 800	33 200	36 900
	12	35 900	35 800	34 400	33 300	32 500	32 800	35 000	33 900	31 700	31 600
Rockwell hardness	0	...	...	M108	...	...	...	...	M111	...	...
	1	M106	M109	...	...	...	M105	M107	...	...	...
	3	M107	M107	M106	M103	M101	M107	M110	M108	M110	M112
	7	M105	M105	M107	M103	M103	M118	M110	M109	M110	M109
	12	M99	M103	M101	M115	M106	M106	M107	M107	M106	M104
Dielectric constant (60 cycles)	0	...	...	4.90	...	...	...	...	4.34	...	...
	1	15.54	7.33	...	...	...	11.44	6.34	...	...	...
	3	10.54	7.32	9.27	13.69	12.08	8.33	5.30	8.20	9.31	10.34
	7	8.71	7.16	12.56	18.95	12.23	10.34	6.18	10.12	15.44	12.48
	12	7.01	13.99	13.50	11.62	15.11	5.91	10.81	8.13	17.03	15.17
Dielectric constant (10^3 cycles)	0	...	...	4.36	...	...	...	...	4.26	...	...
	1	9.79	5.55	...	...	...	9.09	5.08	...	...	...
	3	6.96	5.45	6.00	7.93	7.69	5.85	4.86	6.44	7.28	7.39
	7	5.98	5.36	7.61	9.67	7.41	7.28	5.10	7.41	10.34	8.70
	12	5.28	8.01	7.32	6.14	7.02	4.81	7.94	6.38	8.83	8.12
Dielectric constant (10^6 cycles)	0	...	...	3.84	...	...	...	...	4.03	...	...
	1	4.48	3.96	...	...	...	4.79	3.99	...	...	...
	3	4.08	3.87	3.83	3.84	3.94	3.82	4.08	4.20	4.06	4.25
	7	3.99	3.89	3.86	4.20	4.01	4.28	4.04	4.40	4.68	4.47
	12	4.00	4.31	3.75	3.88	3.97	3.99	4.32	4.13	4.53	4.15
Power factor (60 cycles)	0	...	...	0.083	...	...	...	...	0.022	...	...
	1	0.317	0.202	...	...	...	0.165	0.169	...	...	...
	3	0.285	0.195	0.299	0.315	0.238	0.251	0.148	0.176	0.180	0.142
	7	0.283	0.209	0.328	0.374	0.268	0.241	0.160	0.215	0.230	0.226
	12	0.248	0.323	0.417	0.398	0.457	0.246	0.207	0.193	0.361	0.322
Power factor (10^3 cycles)	0	...	...	0.050	...	...	...	...	0.010	...	...
	1	0.228	0.122	...	...	...	0.116	0.090	...	...	...
	3	0.190	0.119	0.202	0.250	0.217	0.162	0.071	0.108	0.136	0.179
	7	0.177	0.131	0.243	0.268	0.238	0.175	0.087	0.145	0.170	0.198
	12	0.132	0.237	0.244	0.230	0.321	0.091	0.158	0.126	0.273	0.289
Power factor (10^6 cycles)	0	...	...	0.021	...	...	...	...	0.018	...	...
	1	0.115	0.022	...	...	...	0.153	0.022	...	...	...
	3	0.053	0.027	0.039	0.073	0.065	0.037	0.018	0.070	0.098	0.086
	7	0.036	0.024	0.067	0.086	0.070	0.067	0.024	0.101	0.169	0.127
	12	0.024	0.063	0.062	0.031	0.039	0.019	0.106	0.085	0.063	0.069
Color and surface	Samples yellowed to degrees varying with exposure station and period New Mexico samples showing greatest discoloration.										

[a] Data reported for 7-mo. Canada samples were actually obtained for samples mistakenly removed after 6 mo. exposure.

men. The average of 6 determinations is reported as the hardness.

In addition, each specimen is observed for changes in color, warpage, and surface.

The laminated sheet materials are tested for tensile strength and modulus, flexural strength, hardness, and dielectric constant and power factor (at 60, 1000, and 10^6 cycles). Determinations are made in accordance with the methods outlined above. In the case of the materials showing directional properties, all specimens were prepared for testing in the direction of greater strength.

Results and Discussion:

The data obtained on the properties evaluated before and after the various exposures are summarized in Tables I, II, and III, and are arranged to provide comparisons of the changes resulting from the different exposures.

In interpreting the data, it is realized that the observed differences in the results obtained for each material may frequently represent variations in the material due to experimental procedures, or to the use of different sheets of the material, or even to variations within a single given sheet of the material. Some materials showed wider variations in the properties evaluated than other materials. An analysis of the data to establish accurate criteria of significant differences will be made at the conclusion of the 3-yr. program. However, it is possible, from an inspection of the extensive data accumulated after exposures of 1, 3, 7, and 12 months, to estimate and to note the occurrence of various substantial effects. These effects are summarized in Table V for each of the transparent materials and in Table VI for each of the laminated materials.

Conclusions:

In most cases, the samples exposed at New Mexico showed comparatively little or no deterioration. The chief exceptions were the vinyl copolymer which darkened considerably after more than 3 months, and the cast phenolic which discolored and deteriorated in mechanical strength properties after all exposures.

For the phenolic materials, cast or laminated, the Panama exposures were generally more deteriorating in most respects than the exposures at the other stations.

For most of the other materials, the exposures at Panama were no more

TABLE III.—PROPERTIES OF LAMINATED MATERIALS BEFORE AND AFTER OUTDOOR WEATHER AGING.[a]

	Aging Period, months	Melamine-Formaldehyde, Glass Base (GMG)					Silicone, Glass Base (GSG)				
		Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
Tensile strength, psi	0	...	...	29 500	...	...	...	...	23 200	...	...
	1	33 000	30 400	...	...	...	23 100	24 400	...	...	...
	3	36 200	30 500	34 600	31 600	30 700	21 200	21 800	23 100	20 800	23 600
	7	32 300	34 100	30 000	33 900	31 900	21 100	20 900	18 300	20 200	23 200
	12	31 500	34 000	32 800	33 100	33 400	19 400	22 600	21 300	23 300	22 500
Tensile modulus, 10^6 psi	0	...	...	2.73	...	...	...	...	1.69	...	...
	1	2.68	2.42	...	...	...	1.74	1.78	...	...	...
	3	2.51	2.42	2.51	2.44	2.52	1.58	1.66	1.68	1.47	1.65
	7	2.37	2.54	2.16	2.64	2.63	1.52	1.54	1.32	1.39	1.64
	12	2.53	2.45	2.56	2.53	2.55	1.52	1.56	1.56	1.68	1.61
Flexural strength, psi	0	...	...	41 900	...	...	...	...	25 400	...	...
	1	33 100	35 600	...	...	...	22 400	25 400	...	...	...
	3	31 800	32 600	39 300	37 620	35 200	22 800	24 500	21 500	20 600	23 300
	7	37 100	35 400	33 100	34 500	42 700	22 900	25 600	21 400	21 200	22 700
	12	32 000	33 500	34 700	35 000	35 100	23 600	24 200	21 400	21 800	22 200
Rockwell hardness	0	...	...	M123	...	...	...	...	M77	...	...
	1	M116	M118	...	...	...	M85	M88	...	...	...
	3	M115	M117	M119	M119	M120	M83	M87	M81	M81	M85
	7	M114	M115	M116	M118	M120	M86	M87	M83	M75	M83
	12	M113	M114	M116	M115	M119	M80	M85	M81	M75	M78
Dielectric constant (60 cycles)	0	...	...	8.30	...	...	...	...	3.91	...	...
	1	8.01	7.71	...	...	...	4.17	3.90	...	...	...
	3	7.77	7.45	9.82	9.25	9.93	4.08	3.96	4.16	6.12	5.98
	7	9.43	7.52	8.64	9.84	9.46	4.61	3.93	4.68	9.17	7.62
	12	8.31	8.17	8.46	10.03	9.78	4.24	4.13	4.15	5.83	5.55
Dielectric constant (10^3 cycles)	0	...	...	7.08	...	...	...	...	3.75	...	...
	1	7.08	6.99	...	...	...	3.74	3.71	...	...	...
	3	6.89	6.84	7.85	7.34	7.85	3.69	3.72	3.72	4.41	4.88
	7	7.43	6.78	7.15	7.60	7.62	3.89	3.74	4.02	5.22	5.56
	12	7.11	7.00	7.12	7.65	7.49	3.60	3.67	3.79	4.25	4.05
Dielectric constant (10^6 cycles)	0	...	...	6.44	...	...	...	...	3.65	...	...
	1	6.58	6.49	...	...	...	3.54	3.59	...	...	...
	3	6.46	6.48	6.94	6.63	6.63	3.57	3.59	3.53	3.47	3.57
	7	6.67	6.38	6.50	6.62	6.65	3.59	3.63	3.57	3.60	3.67
	12	6.62	6.53	6.56	6.74	6.70	3.44	3.63	3.48	3.58	3.65
Power factor (60 cycles)	0	...	...	0.151	...	...	...	...	0.034	...	...
	1	0.153	0.103	...	...	...	0.122	0.044	...	...	...
	3	0.132	0.087	0.234	0.230	0.205	0.106	0.051	0.099	0.251	0.115
	7	0.243	0.112	0.190	0.228	0.189	0.194	0.053	0.127	0.384	0.210
	12	0.187	0.172	0.178	0.265	0.229	0.205	0.137	0.122	0.294	0.287
Power factor (10^3 cycles)	0	...	...	0.054	...	...	...	...	0.018	...	...
	1	0.052	0.040	...	...	...	0.045	0.022	...	...	...
	3	0.042	0.030	0.084	0.075	0.091	0.033	0.025	0.039	0.135	0.107
	7	0.085	0.039	0.068	0.094	0.082	0.068	0.022	0.065	0.202	0.162
	12	0.057	0.056	0.066	0.104	0.090	0.065	0.038	0.061	0.143	0.119
Power factor (10^6 cycles)	0	...	...	0.008	...	...	...	...	0.003	...	...
	1	0.011	0.012	...	...	...	0.001	0.002	...	...	...
	3	0.011	0.012	0.015	0.015	0.019	0.002	0.002	0.002	0.013	0.026
	7	0.013	0.012	0.013	0.016	0.021	0.004	0.001	0.006	0.021	0.035
	12	0.012	0.013	0.019	0.016	0.015	0.001	0.002	0.011	0.011	0.004
Color and surface		Color faded to degrees varying with exposure station and period.					Color faded to degrees varying with exposure station and period; New York samples soiled by dirt and dust particles imbedded in surfaces.				

	Aging Period, months	Phenol-Formaldehyde, Paper Base (PBG)					Phenol-Formaldehyde, Fabric Base (FBG)				
		Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
Tensile strength, psi	0	...	...	15 800	...	...	...	...	19 100	...	...
	1	14 700	15 600	...	...	...	18 800	18 900	...	...	...
	3	14 100	16 100	16 100	13 800	15 900	18 300	18 800	18 600	17 100	19 200
	7	13 600	15 300	11 500	14 700	16 000	17 400	17 900	14 100	18 100	18 900
	12	12 500	15 100	13 100	14 500	14 200	15 900	18 900	16 100	18 300	19 100
Tensile modulus, 10^6 psi	0	...	...	1.58	...	...	...	...	1.48	...	...
	1	1.44	1.55	...	...	...	1.34	1.38	...	...	...
	3	1.33	1.54	1.59	1.37	1.44	1.34	1.33	1.42	1.25	1.35
	7	1.33	1.51	1.18	1.48	1.49	1.42	1.24	1.09	1.31	1.41
	12	1.26	1.56	1.38	1.47	1.27	1.14	1.37	1.18	1.30	1.40
Flexural strength, psi	0	...	...	21 800	...	...	...	...	29 300	...	...
	1	19 600	23 700	...	...	...	28 300	29 500	...	...	...
	3	19 300	21 100	19 800	19 600	20 100	28 500	29 500	29 000	28 800	28 500
	7	20 300	21 900	19 500	19 100	20 200	25 300	28 900	27 600	27 800	28 500
	12	19 500	20 200	20 900	19 900	19 400	28 500	28 100	28 100	27 400	28 200
Rockwell hardness	0	...	...	M109	...	...	...	...	M107	...	...
	1	M100	M111	...	...	...	M103	M107	...	...	...
	3	M105	M109	M110	M107	M105	M105	M107	M107	M102	M108
	7	M108	M112	M109	M104	M108	M107	M107	M93	M102	M106
	12	M97	M108	M109	M106	M103	M104	M107	M105	M97	M105
Dielectric constant (60 cycles)	0	...	...	7.49	...	...	...	...	19.04	...	...
	1	21.36	7.65	...	...	...	35.42	14.03	...	...	...
	3	18.87	6.96	9.21	10.97	9.71	27.16	10.87	26.38	37.41	33.21
	7	12.66	6.92	10.98	12.06	9.01	20.21	13.46	38.26	48.71	35.50
	12	20.95	9.05	9.33	15.43	17.42	27.98	24.12	31.97	48.77	32.3
Dielectric constant (10^3 cycles)	0	...	...	6.53	...	...	...	...	11.08	...	...
	1	10.41	6.57	...	...	...	13.49	8.55	...	...	...
	3	9.64	6.13	7.04	7.48	7.17	11.13	7.60	11.66	13.63	12.44
	7	7.80	6.17	7.56	7.52	7.05	9.25	7.80	12.53	13.12	11.46
	12	9.11	6.71	7.04	8.14	9.07	11.05	9.62	10.85	12.63	13.53
Dielectric constant (10^6 cycles)	0	...	...	5.55	...	...	...	...	6.10	...	...
	1	6.28	5.44	...	...	...	6.32	5.76	...	...	...
	3	6.18	5.21	5.59	5.59	6.30	6.22	5.49	6.20	6.14	6.22
	7	5.85	5.22	5.79	5.72	5.64	5.90	5.50	6.00	6.22	6.16
	12	5.99	5.52	5.59	6.11	6.15	6.18	5.94	5.93	6.35	6.38
Power factor (60 cycles)	0	...	...	0.225	...	...	...	...	0.514	...	...
	1	0.491	0.160	...	...	...	0.658	0.459	...	...	...
	3	0.477	0.131	0.233	0.338	0.285	0.580	0.370	0.603	0.618	0.629
	7	0.373	0.124	0.340	0.350	0.259	0.517	0.412	0.596	0.646	0.620
	12	0.502	0.255	0.281	0.376	0.469	0.549	0.546	0.583	0.634	0.703
Power factor (10^3 cycles)	0	...	...	0.072	...	...	...	...	0.311	...	...
	1	0.293	0.065	...	...	...	0.420	0.215	...	...	...
	3	0.260	0.051	0.105	0.142	0.113	0.321	0.153	0.350	0.414	0.390
	7	0.131	0.048	0.136	0.135	0.098	0.246	0.165	0.368	0.383	0.344
	12	0.241	0.094	0.109	0.169	0.236	0.338	0.288	0.336	0.389	0.418
Power factor (10^6 cycles)	0	...	...	0.056	...	...	...	...	0.083	...	...
	1	0.066	0.054	...	...	...	0.085	0.072	...	...	...
	3	0.066	0.052	0.055	0.060	0.051	0.080	0.063	0.083	0.095	0.091
	7	0.063	0.053	0.060	0.058	0.061	0.077	0.066	0.090	0.090	0.092
	12	0.055	0.053	0.064	0.062	0.064	0.079	0.070	0.103	0.091	0.094
Color and surface		In New York samples, surfaces changed from glossy black to dull black.					In New York samples, surfaces changed from glossy black to dull black; the samples exposed at other stations showed deterioration of surface resin varying with exposure station and period.				

[a] Data reported for 7-mo. Canada samples were actually obtained for samples mistakenly removed after 6 mo. exposure.

TABLE IV.—PROPERTIES OF MOLDED TERMINAL BLOCKS BEFORE

	Period, months	Phenolic, Cellulose Filler (CFG)					Phenolic, Cotton Filler (CFI-20)				
		Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
Insulation resistance, megohms	0	...	...	30 000	...	...	...	...	3000	...	...
	6	3000	10 000	3 000	1000	10 000	3000	3 000	1000	1000	1000
	12	3000	3 000	3 000	3000	3 000	3000	10 000	1000	1000	1000
Dielectric strength,[a] step by step. kv	0	...	...	10+	...	...	...	...	7	...	...
	6	9+	10+	10+	10+	10+	6+	8+	6	6	6
	12	9+	10+	10+	10+	10+	6+	10+	7	6	6
Shock resistance,[b] (HI) fracture load, lb.	0	...	...	0.07	...	...	...	...	0.22	...	...
	6	0.04−	0.02	0.05	0.03	0.11−	0.22	0.28	0.23	0.29	0.31
	12	0.02−	0.05	0.07−	0.05	0.08	0.35	0.27	0.36	0.27	0.32

[a] The + sign indicates that a flashover occurred in the tests on one or more of the 6 samples, and that the actual dielectric strength is greater than the valu reported.
[b] The − sign indicates that failure occurred at the initial blow in tests on one or more of the 6 samples, and that the actual shock resistance is less than th value reported.

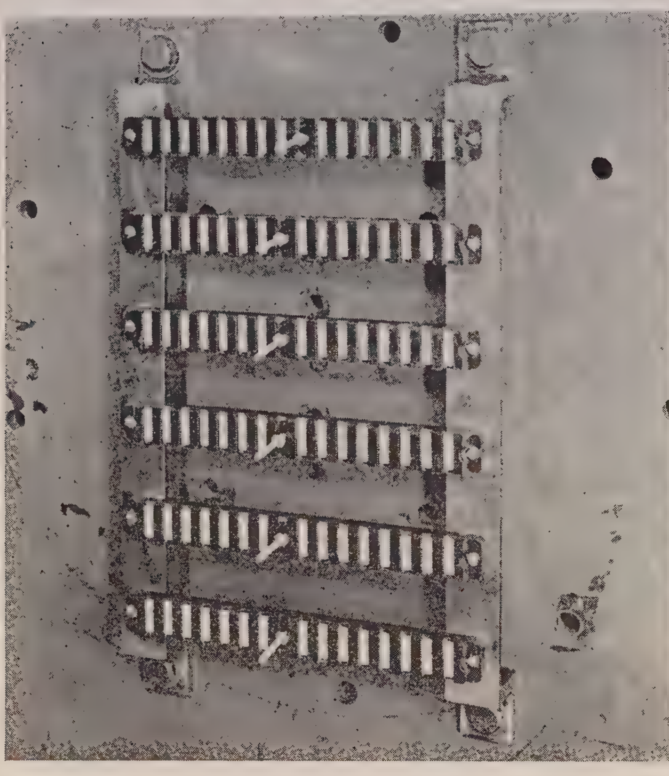

Fig. 3.—Molded Terminal Blocks Mounted for HI Shock Test.

severe than the exposures at New York, Canada, or Alaska, and in several respects, even less severe. At the exposure station in New York, the temperate climate, which under natural conditions would produce moderate deterioration in most materials, is conditioned by a local environmental factor—atmospheric contamination with dust, smoke, and industrial gases. For some materials, particularly the cellulose acetate and cast phenolic, this atmospheric contamination appeared to be the most serious factor in accelerating deterioration. In the case of the glass-silicone laminate, the exposures at Canada and Alaska proved most severe in that the dielectric constant and power factor properties of the exposed samples showed considerable increases.

A comparison of the changes occurring in the Canada samples with the changes occurring in the Alaska samples indicates that, for the materials reported, the effects of the exposures in Canada and Alaska were essentially similar.

The cast phenolic material showed greater differences in the effects produced by the different exposure conditions than any of the other materials. The Panama samples, for example, showed considerable discoloration, decreased tensile modulus and hardness and increased dielectric constant and power factor. These effects contras sharply with the slight discoloration, in creased tensile modulus, relatively un affected hardness, and improved electri cal properties shown by the New Mexic samples. The samples exposed at New York were characterized by othe changes that affected the color, trans mission, haze, and surface characteri tics of the material. The Canada an Alaska samples were characterized b comparatively lesser changes that a fected chiefly the tensile and flexura strength.

The transparent materials least a fected, on the whole, by the exposures a all 5 stations were methyl methacryla and allyl resin. These materials, aft one-year exposure under the differe climatic conditions, showed occasion reductions in mechanical strength pro erties, but no serious impairment of th serviceability of the material. The sar ples after being washed were indisti guishable in appearance from the une posed samples.

Of the six laminated materials inves gated, the glass-melamine was the lea affected, on the whole, by the exposu at all 5 stations. This material, aft one-year exposure, under the differe climatic conditions, did not show serio impairment of the properties evaluate

Although most of the laminat showed some reduction in the mecha cal strength properties, the deterior tion produced by the different clima conditions was, in general not su ciently serious to affect the servi ability of the materials in mechani applications.

The dielectric constant and pow factor properties of the transparent m terials investigated were negligibly fected except in the case of the cast ph nolic material, which showed apprec ble deterioration after exposures Panama and slight improvement af exposures in New Mexico. The effe of the exposures on the dielectric c stant and power factor properties

Phenolic, Mineral Filler (MFI-20)					Melamine, Cotton Filler (C-3)					Melamine, Glass Filler				
Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska	Panama	New Mexico	New York	Canada	Alaska
...	...	300	...	...	...	...	300 000	...	...	...	...	300 000	...	...
100	100	100	300	100	100 000	100 000	30 000	100 000	30 000	30 000	300 000	100 000	100 000	100 000
300	300	100	100	100	10 000	100 000	30 000	100 000	100 000	100 000	300 000	10 000	100 000	100 000
...	...	4	...	...	...	...	10+	...	...	...	...	10+	...	...
4	5	4	3	3	10+	10+	10+	10+	10+	10+	10+	11+	11+	11+
4	5	4	3	2	10+	10+	10+	10+	10+	11+	11+	10+	10+	11+
...	...	0.25	...	...	...	...	0.14	...	...	...	...	0.16	...	...
0.28	0.32	0.25	0.36	0.37	0.17	0.20	0.10	0.19	0.18	0.18	0.22	0.14	0.21	0.20
0.47	0.29	0.39	0.28	0.46	0.14	0.11	0.13	0.13	0.19	0.25	0.14	0.25	0.13	0.21

the laminated materials varied considerably. However, the New Mexico samples of each material, in general, showed the least effects, and in some cases even showed improvement of the electrical properties. The results, on the whole, appear to indicate that, for most materials, the abundance or lack of moisture is a significant climatic factor affecting the electrical properties of the material. However, the silicone-glass laminate furnished an interesting exception; this material showed appreciably increased dielectric constant and power factor values after exposures at Canada and Alaska, and generally slight or negligible changes after exposures at the other stations.

It is also to be noted that the dielectric constant and power factor properties determined at 10^6 cycles were, for most materials, relatively unaffected by outdoor weather aging. The chief exceptions were the two low-pressure glass laminates and the silicone-glass laminate.

The influence of exposure time for each material at each exposure station, as deduced from the data obtained, has been summarized in Tables V and VI under "Effects apparently arising from differences in period of exposure." It is interesting to note that, although the changes occurring in the properties of the materials were generally of the deteriorative type, relatively few exposures were characterized by progressive deterioration. Changes in which the deterioration increased as the period of exposure increased, occurred chiefly in the light transmission and haze properties for some exposures, the tensile strength properties of the phenolic laminates exposed at Panama, and the tensile modulus and flexural strength properties of the styrene phthalate laminate exposed at most stations. Changes in which the effects were characterized by improvement, recovery, or "cycling" were also noted in a few cases.

For the materials investigated in this report, effects that may be attributed chiefly to differences in the solar radiation at the various stations were observed in a few instances only. The deterioration in the vinyl copolymer samples exposed at Panama and New Mexico appeared to be chiefly photochemical in character and to result from the strong ultraviolet radiation occurring in these regions. In several of the laminates, notably the glass-melamine and glass-silicone materials, the rate at which the surfaces discolored varied inversely with the latitude of the exposure station.

Exposures of the materials are continuing with tests scheduled after 18, 24, 30, and 36 months' outdoor weather aging and 36 months' indoor shelf aging.

Part III. Weather Aging Program on Molded Terminal Bars

Materials:

Several types of materials were used in molding the terminal blocks included in the program, as follows:

1. Cellulose filled phenolic, Navy Type CFG, wood flour filler.
2. Cellulose filled phenolic, Navy Type CFI-20, cotton fabric filler.
3. Mineral-filled phenolic, Navy Type MFI-20, asbestos filler.
4. Cellulose-filled melamine, Navy Type G-3, chopped cotton filler.
5. Glass-filled melamine, glass filler.

Periods and Methods of Exposure:

Each exposure panel contains 6 terminal blocks, each mounted with aluminum bolts and equipped with brass bus bars. The panels are mounted on the racks as shown in Fig. 1. The program provides for outdoor weather exposures of 6, 12, and 24 months at all 5 exposure stations, and an indoor shelf exposure of 24 months under standard laboratory conditions (25 C. and 50 per cent relative humidity).

Test Methods:

The molded terminal blocks are tested for insulation resistance, dielectric strength (step-by-step), and high impact shock resistance.

The insulation resistance is measured with a 500-v., 10^6-ohm bridge. Each reading is made 1 min. after the current is applied. Measurements on each type of material are made on 4 barriers of each of 6 terminal blocks. The average of the 24 measurements is reduced to the nearest half decade and reported as the insulation resistance.

The dielectric strength is determined with a 50-kv., 5-kva. dielectric test set with hand-controlled auto-transformer. Voltage increments are in general accordance with the method outlined in Joint Army-Navy Specification JAN-P-14.[11] One step-by-step measurement on each terminal block is made, and the average value obtained for the 6 specimens is reported as the dielectric strength.

The shock resistance is determined with a high impact (HI) shock machine[12], of the type described in Navy Department Specification 66S3. Six specimens are mounted on the anvil plate of the machine (Fig. 3) and simultaneously subjected to repeated shock blows of 2000 ft-lb. energy. The severity of the shock is increased by means of an inertial load consisting of a weight which is securely fixed to the terminal block at the center by means of a nut and bolt. This inertial load is increased in steps of 0.05 lb. between successive blows. The shock resistance of a sample is expressed in terms of the minimum inertial load required to cause fracture of the specimen. The average obtained for the 6 specimens is reported as the shock resistance.

Results:

The results of the various tests and observations on the materials before and after exposure are summarized in Table IV.

Conclusions:

It is apparent from an inspection of the results summarized in Table IV that the 6-month and 1-year exposures produced some changes in the properties

[11] Joint Army-Navy Specification JAN-P-14 September 30, 1944, As Amended; Plastic Materials, Molded Thermosetting.

[12] Navy Department Specification 66S3, September 15, 1945, As Amended; Shockproof Equipment, Class HI (High Impact) and Tests For.

TABLE V.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON CLEAR TRANSPARENT PLASTIC SHEET MATERIALS.

	Effects of Tested Properties Apparently Arising from Climatological Differences	Effects on Color and Surface Apparently Arising from Climatological Differences	Effects Apparently Arising from Differences in Period of Exposure					General Effects
			1, 3, 7, and 12 months		3, 7, and 12 months			
			Panama	New Mexico	New York	Canada	Alaska	
Methyl methacrylate	New York, Canada, and Alaska samples showed decreased tensile strength; New York Samples showed decreased flexural strength and increased haze.	New Mexico samples showed very slight yellowing after 12 mo.	....	....	7- and 12-mo. samples showed decreased tensile strength and increased haze.	3- and 7-mo. samples showed decreased tensile strength, but 12-mo. samples showed recovery.	All exposures showed decreased tensile strength, but 12-mo. samples showed slight recovery.	No serious impairment of serviceability of material.
Cellulose acetate	Tensile strength and hardness decreased after all exposures; New York samples showed considerable deterioration in transmission and haze. Panama samples showed greatest decrease in hardness. Alaska samples showed increased haze.	New York samples showed very severe crazing of the surface. Samples exposed at all stations warped. Panama samples showed greatest warpage.	....	....	Transmission, haze, tensile strength, and crazing increased with period of exposure.	....	....	Deterioration at all stations, particularly at New York.
Allyl resin	Occasional decreases in flexural strength at all stations.	....	....	....	....	....	7- and 12-mo. samples showed decreased flexural strength	No serious impairment of serviceability of material.
Vinyl copolymer	Panama and New Mexico samples showed deterioration in tensile strength, transmission, and haze. New York samples showed decreased tensile strength and slight discoloration.	Panama and New Mexico samples showed severe discoloration; New York samples showed slight discoloration.	7- and 12-mo. samples showed deterioration.	7- and 12-mo. samples showed deterioration. 12-mo. samples almost completely opaque.	7- and 12-mo. showed decreased tensile strength; 12-mo. samples showed discoloration	....	....	Deterioration at Panama, New Mexico, and New York.
Cast phenolic	Panama samples showed deterioration in practically all the properties evaluated; New Mexico samples showed deteriorated tensile and flexural strength, but improved dielectric constant and power factor properties and increased tensile modulus. New York samples showed severe deterioration in strength properties, haze, and transmission. Canada and Alaska showed lesser deterioration in tensile and flexural strength.	Panama and New York samples showed severe discoloration and crazing; samples exposed at the other stations showed lighter discoloration. Panama samples warped after all exposures.	Samples show cyclic effects in dielectric constant and power factor properties.	Dielectric constant and power factor decreased with period of exposure.	Transmission decreased, haze and crazing of the surface increased with period of exposure.	....	....	Deterioration at all stations, the Panama and New Mexico samples showing the most severe effects.

TABLE VI.—SUMMARY OF APPARENT EFFECTS OF OUTDOOR WEATHER AGING ON LAMINATED PLASTIC SHEET MATERIALS.

	Effects on Tested Properties Apparently Arising from Climatological Differences	Effects on Color and Surface Apparently Arising from Climatological Differences	Effects Apparently Arising from Differences in Period of Exposure: 1, 3, 7, and 12 months		3, 7, and 12 months			General Effects
			Panama	New Mexico	New York	Canada	Alaska	
Styrene maleate polyester, glass base..........	Samples exposed at all stations except New Mexico showed decreased tensile strength; samples exposed at all stations showed increased dielectric constant and power factor, but in the case of the New Mexico samples, the increases were generally smaller for exposures up to 7 mo. The New Mexico samples also showed increased tensile modulus.	Samples exposed at all stations yellowed, but to a greater extent after exposures in New Mexico, and to a slight extent after exposures in Canada and Alaska.	7- and 12-mo. samples showed decreased tensile strength; magnitude of increases in electrical properties diminished with exposure period.	12-mo. samples showed sharper increase in electrical properties than samples exposed for shorter periods.	7- and 12-mo. samples showed decreased tensile strength.	7- and 12-mo. samples showed decreased tensile strength.	7- and 12-mo. samples showed decreased tensile strength.	General deterioration in tensile strength and electrical properties.
Styrene phthalate polyester, glass base............	Samples exposed at all stations showed decreased tensile modulus and increased dielectric constant and power factor; the New Mexico samples showed for exposures up to 7 mo. smaller increases in the electrical properties than the samples exposed at the other stations.	Surface and color effects same as for styrene maleate laminate.	Tensile modulus and flexural strength decreased with exposure period.	Tensile modulus increased with period of exposure. 12-mo. samples showed sharper increase in electrical properties than 1-, 3-, and 7-mo. samples.	Tensile modulus and flexural strength decreased with exposure period.	Tensile modulus and flexural strength decreased with exposure period.	Tensile modulus and flexural strength decreased with exposure period.	General deterioration in electrical properties.
Melamine-formaldehyde glass base, (GMG)....	Samples exposed at all stations showed increased tensile strength and decreased flexural strength. Panama, New Mexico, and New York samples showed slight or negligible effects in the dielectric constant and power factor properties; the Canada and Alaska samples showed slight increases in the electrical properties at 60 cycles.	Samples faded, the rate of fading varying inversely with the latitude of the exposure station.	1-, 3-, and 7-mo. samples showed increased tensile strength. Fading increased with exposure period.	7- and 12-mo. samples showed increased tensile strength. Fading increased with exposure period.	3-mo. samples showed increased tensile strength. 7- and 12-mo. samples showed decreased flexural strength. Fading increased with exposure period.	7- and 12-mo. samples showed increased tensile strength. Fading increased with exposure period.	12-mo. samples showed increased tensile strength. Fading increased with exposure period.	No serious impairment of the serviceability of the material.
Silicone glass base (GSG)..........	Samples exposed at all stations except Alaska showed decreased tensile strength; samples exposed at all stations except New Mexico showed decreased flexural strength. Canada and Alaska samples showed increased dielectric constant and power factor; samples exposed at the other stations showed increases in the power factor only. Samples exposed at all stations showed increased hardness but the Canada and Alaska samples lost the increases before the end of 12 mo.	Samples faded, the rate of fading varying inversely with the latitude of the exposure station. New York samples showed soiling by the dirt and dust particles.	Fading increased with exposure period.	12-mo. samples showed increased power factor. Fading increased with exposure period.	Fading increased with exposure period.	3- and 7-mo. samples showed decreased tensile strength but 12-mo. samples showed recovery. Fading increased with exposure period.	....	General deterioration in strength at moststations, deterioration in electrical properties chiefly at Canada and Alaska.
Phenol-formaldehyde, paper base (PBG)..........	Samples exposed at all stations except New Mexico showed decreased tensile strength, tensile modulus, and flexural strength, and increased dielectric constant and power factor (60 cycles and 10^3 cycles); the deterioration shown by the Panama samples was generally greater than that shown by the samples exposed at the other stations.	New York samples turned from a glossy black to a dull black.	Tensile strength decreased with exposure period.	....	7- and 12-mo. samples showed decreased tensile strength.	....	12-mo. samples showed decreased tensile strength.	Deterioration at most stations, particularly at Panama.
Phenol-formaldehyde, fabric base (FBG)......	Panama and New York samples showed decreased tensile strength and tensile modulus; Canada samples showed decreased tensile modulus. Samples exposed at all stations except New Mexico showed some increases in dielectric constant and power factor; the New Mexico samples, however, showed decreases in the electrical properties.	Surface resin showed deterioration at all stations, but to a greater extent at Panama, and to a very slight extent in Canada and Alaska. New York samples changed from a glossy black to a dull black.	Tensile strength decreased with exposure period.	12-mo. samples showed deterioration of surface resin.	....	12-mo. samples showed deterioration of surface resin.	12-mo. samples showed deterioration of surface resin.	Deterioration at most stations.

evaluated, but these changes were, on the whole, not sufficient to affect seriously the serviceability of the samples tested. Differences in the effects observed varied but slightly with the different climatic conditions.

Acknowledgment:

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Note.—In the course of the investigation, it was found necessary in the case of some materials to modify the method of calculating the dielectric constant and power factor properties from the capacitance and dissipation factor measurements. This modification, which provides for applying a correction factor under special conditions, is made in order to realize the maximum accuracy of the measuring test circuit. For most of the materials and exposures, the correction factors are negligible; for others, the correction factors are slight and do not affect the reported values more than 10 per cent. In a few cases, chiefly the fabric base phenolic laminate, at 60 cycles, the correction factors are sufficiently appreciable to be taken into account. However, the discussion of the effects noted and the conclusions drawn on the basis of the data reported are in no way affected by the corrections. It is proposed to recalculate the dielectric constant and power factor values in the few cases necessary and to include the corrected values in the final report that will be prepared at the completion of the 3-yr program.

ADDENDUM

Further Effects of Outdoor Weather Aging of Plastics Noted After Exposures for Two Years

The paper presented above represents a summary of the results obtained for the first 12 months of the 3-yr program. Additional data accumulated during the second year of the program and obtained for exposure periods of 18 and 24 months have become available since the paper's presentation at the annual meeting. These data will be included in the final complete report which will be prepared at the termination of the 3-yr program, approximately in December, 1951. However, a few interesting and general effects that may be noted from the additional data accumulated are briefly summarized in the following paragraphs.

Methyl Methacrylate:

This material continued to show no serious impairment of its surface appearance, except for slight yellowing in the New Mexico samples. The Panama samples appeared to show incipient decrease in tensile strength; on the other hand, the samples exposed at the other stations, after showing decreases in tensile strength, now appeared to show recovery effects. The Panama samples exposed for 24 months showed a more than 50 per cent decrease in flexural strength.

Cellulose Acetate:

The deterioration in mechanical strength and surface conditions showed a marked increase after exposures at all stations except Canada. The New York samples, in particular, continued to show increasingly severe deterioration, the light transmission dropping to 47 per cent and the haze increasing to 88 per cent. The Alaska samples showed surface deterioration extending over the exposed surface and characterized by clouding, warpage, and crazing. This deterioration, which was not observed in previous exposures, is reflected in the decrease in light transmission to 73 per cent and increase in haze to 28 per cent.

Allyl Resin:

The samples showed evidence of deterioration as follows:

Panama—Slightly yellowed; tensile and flexural strength decreased appreciably.

New Mexico—Slightly yellowed; flexural strength decreased considerably.

New York—Except for a very slight increase in haze (6 per cent), deterioration was slight or negligible.

Canada—No evidence of appreciable deterioration was found except for a continued decrease in flexural strength.

Alaska—Fexural strength which had decreased during the first year of exposure showed evidence of recovery; however, the surface of portions of the exposed areas showed some deterioration.

Vinyl Copolymer:

The Panama and New Mexico samples had darkened to complete or almost complete opaqueness. The New York samples had darkened considerably, the light transmission dropping to 40 per cent and the haze increasing to more than 10 per cent. The Canada and Alaska samples showed very slight discoloration. The mechanical strength and electrical properties evaluated continued to show slight or negligible changes.

Cast Phenolic:

The samples showed increased discoloration and surface deterioration at all exposure stations. The New York samples continued to show the most severe effects, the light transmission dropping to less than 45 per cent and the haze increasing to approximately 80 per cent. The Alaska samples showed surface deterioration effects not previously observed; these effects, which included crazing and pitting, decreased the light transmission to 70 per cent and increased the haze to 18 per cent. Evidence of any further deterioration or changes in mechanical strength and electrical properties was slight or negligible.

Low-Pressure Polyester Resin Glass Laminates:

Both the styrene maleate polyester and the styrene phthalate-glass laminates showed no appreciable evidence of any further deterioration in the mechanical properties evaluated. The dielectric constant and power factor properties determined for frequencies of 60 cycles and 1000 cycles were affected as follows: The magnitude of increases were, in most cases, less for the Panama, New Mexico, and New York samples and considerably greater for the Canada and Alaska samples.

Melamine Glass Laminate:

The mechanical and electrical properties evaluated continued to show slight or negligible effects except for the dielectric constant and power factor properties of the Alaska samples measured at 60 and 1000 cycles; these showed marked increases after the 18- and 24-month exposures.

Silicone Glass Laminate:

The mechanical and electrical properties showed slight or negligible evidence of any further deterioration or change, except in the case of the Alaska samples. The dielectric constant and power factor values for the samples exposed 18 months at this exposure site showed marked increases. The 24-month samples, however, recovered to approximately the values obtained for shorter exposure periods.

Phenolic Paper Base and Fabric Base Laminates:

The 18- and 24-month samples showed no appreciable evidence of any further deterioration or change.

The occurrence of certain appreciable effects in several materials after exposure of 18 and 24 months in Alaska is noteworthy—for example, the accelerated surface deterioration in cellulose acetate, allyl resin, and cast phenolic and the s

celerated increases in dielectric constant and power factor at 60 and 1000 cycles in the melamine and silicone glass laminates. These effects appear to indicate that the exposure conditions at Point Barrow, Alaska, may be influenced by many complex factors peculiar to the climate and locality. A possible explanation may be sought by considering the effects in conjunction with the absence of similar or equal effects in the Canada samples which are exposed at an inland site. One of the factors suggested by this comparison is the prevalence of freezing temperatures combined with nearness of the exposure site to the salt atmosphere conditions provided by the Arctic Ocean. It is probable that the effects observed may represent the action of the salt atmosphere on the particular materials affected. The effects on the transparent materials showing surface deterioration appear to be such as might occur if the materials were exposed to salt spray conditions for very prolonged periods. It is hoped that the additional data accumulated after the 30- and 36-month exposure will throw further light on what appears to be anomalous behavior.

The 24-month exposure of the various phenolic and melamine molded terminal bars will complete the weather aging exposure schedule of these materials. A preliminary inspection of the data obtained indicated that the exposures at all stations had produced, in most cases, no appreciable changes in the insulation resistance and dielectric strength properties but had produced evidence of slight improvement in the HI shock resistance property. The following exceptions were tentatively noted: The mineral-filled phenolic (MFI-20) showed evidence of increased dielectric strength after the New Mexico exposures but decreased dielectric strength after the Alaska exposures; also, the cellulose-filled phenolic (CFG) showed evidence of slight deterioration in the HI shock resistance property. Complete test data obtained will be presented in the final report. This report will also include the results of a similar exposure program now being conducted on glass-filled silicone molded terminal bars.

DISCUSSION

Mr. W. M. Gearhart.[1]—We have conducted weather exposures for about ten years, at locations in Arizona, Tennessee, and Florida. I can only comment on the cellulosics.

We have noticed a much more severe breakdown for cellulosics in Florida, where there is moisture and fungus growth. This breakdown begins in 4 or 6 months.

In Arizona the breakdown was quite rapid, in roughly 6 months, and a lot of the cellulose acetate samples were completely brittle. This breakdown is attributed largely to photochemical action, presumably a photooxidation of some type.

Mr. S. E. Yustein (*author*).—As mentioned in the paper, the chemical effect is particularly pronounced on the vinyl copolymer material. This material showed peculiar effects. At the end of 3 months, in the vinyl copolymer, there was no change in appearance. But when the 7-month samples were received there was a pronounced discoloration in the Panama and New Mexico samples and no effects in the samples exposed at the other stations.

At the end of 12 months, the effects in Panama and New Mexico had increased. The discoloration was extremely marked in the New Mexico samples; the samples were almost opaque. The discoloration was due to an effect on the surface layer. Oddly enough, if you scratch off the surface layer you almost restore the transparency of the specimen. However, you cannot wash away the discoloration.

Some of the effects Mr. Gearhart has described in connection with the Florida exposures, I have also noted in connection with the Panama exposures.

Mr. Gearhart.—I believe the authors used cellulose acetate plasticized with diethylphthalate but no mention is made of the use of an inhibitor. All our tests indicate that the exposure of cellulose ester plastics without an inhibitor leads to rapid breakdown. The inclusion of 1 per cent inhibitor (for example phenylsalicylate) will greatly extend the life of the exposed plastic. We feel that the exposure of uninhibited cellulosics does not give a true picture of the possible weathering ability attainable with these plastics.

Mr. J. W. Mighton.[2]—Have the authors a means of recording the amount of sun's radiation at the various sites?

Mr. Yustein.—We have, in conjunction with this program, set up pyrheliometers at Alaska and New York. There is also one operated by the Army at Fort Churchill.

We are collecting solar radiation data and I believe that when the next report is prepared, some correlation among radiation, test site, and effects might be made.

Several effects that may be associated with differences in the latitude of the exposure station were noted. One of these effects was the pronounced change in color shown by the melamine glass laminate, which discolored at a rate that varied indirectly with the latitude of the exposure station. Other effects noted will be studied and discussed in subsequent reports.

Mr. C. A. Neros.[3]—Has any attempt been made to correlate the results with accelerated weather data? If not, do the authors intend to include a study of accelerated weathering data in their final report?

Mr. Yustein.—No. No provision was made in this program for correlating that data; some attempts have been made previously to do that. As far as I know, no successful correlation was made.

Chairman R. E. Hess.[4]—I should like to ask whether a photographic record is being kept on the appearance. In some exposure programs, a record is kept by means of Kodachrome slides.

Mr. Yustein.—We have samples cut from the exposed samples mounted on panels, which will be, at the end of the 3-year program, assembled for purposes of comparison. The chances are they will be photographed.

Mr. F. W. Reinhart.[5]—I think photographs should be taken. We had a group of samples on the roof when the war started, and due to the pressure of work, we stored them in an air conditioned room. Two years later we got a chance to look at them, but the samples had deteriorated so far that they weren't worth testing. It seems that once that deterioration starts, it doesn't stop.

Mr. Yustein.—As far as the deterioration is concerned, they may deteriorate after, say, a short period of exposure, but no further deterioration may occur. In some of the materials the deterioration occurred, say, after 3 months, and then the properties evaluated remained at those values for subsequent periods of exposure. That occurred in a great many of the materials.

[1] Tennessee Eastman Corp., Kingsport, Tenn.

[2] Plastics Technical Service, The Dow Chemical Co., Midland, Mich.

[3] Research Chemist, Research and Development Dept., Diamond Alkali Co., Painesville, Ohio.

[4] Technical Secretary and Editor, American Society for Testing Materials, Philadelphia, Pa.

[5] Chemist, National Bureau of Standards, Washington, D. C.

Comparison of Reflectance Readings of Traffic Paints

By Tilton E. Shelburne[1]

The Virginia Department of Highways inaugurated, in August, 1949, an extensive series of field experiments to evaluate the performance of several traffic marking paints. Both plain and reflectorized paints were studied. One phase included the securing, at periodic intervals, of reflectance readings for the geometric conditions of night use on the highway where the paints are illuminated and viewed at near-grazing angles. For this purpose the Hunter night visibility meter[2] was used. The instrument is of a visual type chosen by Mr. Hunter because of the need for portability and economy and because of the difficult geometric conditions under which reflectance measurements must be made. It was thought that such an instrument would be extremely valuable in securing numerical ratings of night reflectance for the various paints as well as an aid in evaluating their durability under actual and accelerated conditions.

The ASTM Standard Method of Conducting Road Service Tests on Traffic Paints (D 713–46) was employed except that in addition to the transverse lines for accelerated tests, short longitudinal lines of reflectorized paints were installed. Extreme care was used in applying the paints to secure a uniform film thickness of 0.015 in. Reflectorization was secured by means of beads-on-paints and beads-in-paints. The rate of application of the beads on the paint was 6 pounds per gallon. The beads were uniformly graded between the No. 20- and No. 100-mesh sieves. When incorporated in the paint smaller beads were used (No. 70 to No. 230 sieves).

During the study, another reflectometer was available for a limited time. This meter was developed by the Minnesota Mining and Manufacturing Co.[3] We understand that only one or two of these instruments have been built and that they are not available commercially.

Several readings were secured with the two instruments both on standard laboratory panels and on field test sections. It was hoped that a correlation between the two instruments might thus be secured. The purpose of this paper is not to discuss the design or relative merits of the two reflectometers but merely to present the data secured from this portion of the study. Some comments are made on difficulties encountered in making measurements.

Discussion of Test Data:

The data secured in this phase of the study are shown completely in Table I and are presented graphically in Fig. 1. The three field test locations were designated "A," "B," and "H." The lines at location "A" were on an abandoned portion of road and subjected to weathering only. Lines at "B" were on U. S. Route 250 which is a two-lane 22-ft. pavement with an F-1 sand-asphalt (Va. designation) wearing surface. The traffic count on the average day of the year is 2414 vehicles. The transverse lines were subjected to more wear than the longitudinal lines. This accounted for the higher readings on the longitudinal lines. Section "H" was also located on U. S. Route 250 west of Charlottesville where the surface is a bituminous plant mix (F-1 sand asphalt); however, in this case the road consists of three lanes. Only one paint was employed with different types and gradations of beads.

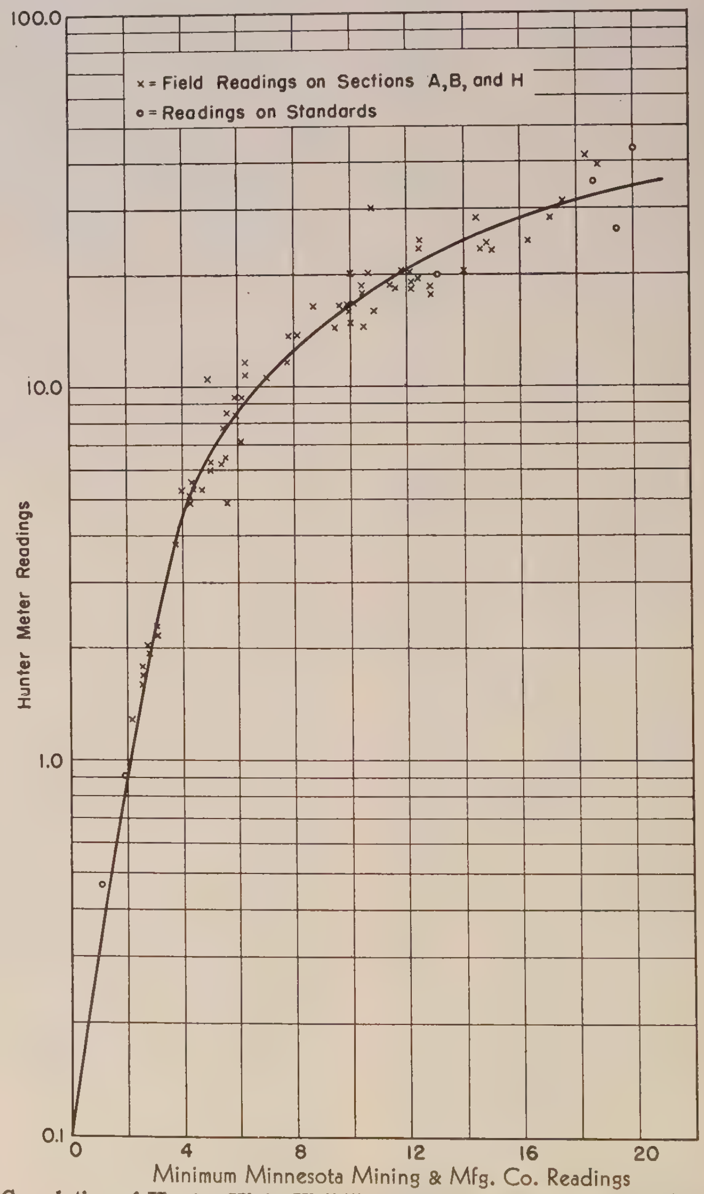

Fig. 1.—Correlation of Hunter Night Visibility Meter Readings with Minnesota Minin[g] and Mfg. Co. Photometer Readings.

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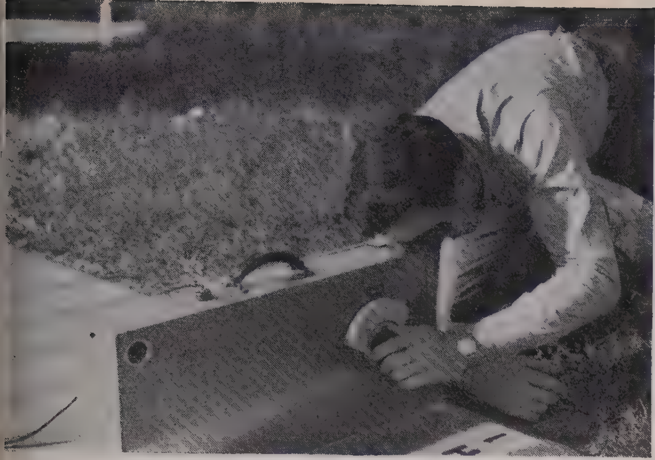
[1] Director of Research, Virginia Department of Highways, Charlottesville, Va.

[2] R. S. Hunter, "Night Reflectance of Traffic Paints and Signs," *Traffic Engineering*, Vol. 17, August, 1947, p. 466.

[3] John M. Hill and Howard W. Ecker, "A Direct Reading Portable Photoelectric Photometer for Determining Reflectance of Highway Centerlines," ASTM Bulletin, No. 159, July, 1949, p. 69.



ig. 2.—Reflectance Readings Being Measured by the Hunter Night Visibility Meter.

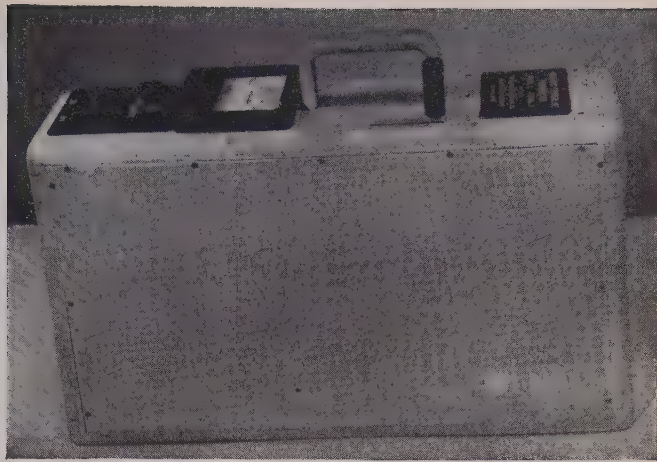


Fig. 3.—Minnesota Mining and Manufacturing Co. Photometer.

In all cases duplicate transverse lines ere installed (that is, 1 and 21, 2, 22, tc.). Five readings were secured on ach line. At each location the number f readings averaged for each value given n Table I are 10 for transverse lines and for longitudinal lines except as noted.

Figure 1 compares graphically the eadings secured by the two instruments n the same laboratory standards and he road lines. Readings secured by he meters were plotted on scales coresponding to those on the instruments—logarithmic for the Hunter neter and linear for the Minnesota Mining photometer. It thus appears hat reflectance readings from the two nstruments correlated reasonably well. ow readings with the Hunter instrument may be more easily read because of the logarithmic scale.

Operation of Instruments:

During the year that we have been operating the Hunter meter, several thousand measurements have been made with it and it may be appropriate at this time to point out difficulties that have been encountered. In the first place, readings on the road are not easy to make as illustrated by Fig. 2. Two men alternate in making readings—one recording and the other reading the instrument.

While the Minnesota Mining photometer (Fig. 3) was used only a short time, certain items concerning operation were observed. It was found, particularly on a rough-textured surface, that stray light was much more critical, and in such cases a black cloth or skirt had to be draped around the instrument if reliable readings were to be secured. Readings with this instrument, however, could be made rapidly with ease since it required merely placing the photometer on the line, pushing a button and reading the scale directly.

Conclusion:

It is believed that either or both instruments can be used successfully in evaluating reflectance and durability of traffic marking paints. It is hoped that the data presented here may be useful to others in comparing values measured by the two instruments.

ABLE I.—CORRELATION OF HUNTER NIGHT VISIBILITY METER READINGS WITH MINNESOTA MINING AND MANUFACTURING CO. PHOTOMETER READINGS.

Section "A"—Field Test (No Traffic)

Type of Paint	Line Numbers	Hunter Meter Readings	Minn. M&M Photometer Readings
Plain (diagonal lines) (10)a	1, 21	5.3	4.7
	2, 22	5.0	4.2
	3, 23	5.2	4.0
	4, 24	5.0	4.2
	5, 25	5.4	4.5
	6, 26	5.4	4.3
	7, 27	7.3	6.1
	8, 28	6.5	5.5
Beads on paint (diagonal lines) (10)	41, 61	31.4	17.6
	42, 62	20.3	14.0
	43, 63	24.9	12.4
	44, 64	17.9	10.4
	45, 65	18.7	12.7
	46, 66	18.8	11.4
	47, 67	24.4	14.7
	48, 68	28.0	14.4
	49, 69	9.3	5.8
	50, 70	8.5	5.6
	51, 71	9.3	6.0
Beads in paint with beads on paint (diagonal lines) (5)	69	28.2	16.9
	70	39.6	18.7
	71	42.4	18.3

a Number in parentheses indicates the number of readings that were averaged to obtain values in columns.

Section "B"—Field Test

Type of Paint	Line Numbers	Hunter Meter Readings	Minn. M&M Photometer Readings
Plain (transverse lines) (10)	1, 21	2.3	3.1
	2, 22	1.9	2.9
	3, 23	2.3	3.1
	4, 24	1.7	2.6
	5, 25	1.3	2.2
	6, 26	1.7	2.6
	7, 27	1.7	2.6
	8, 28	2.0	2.8
Beads on paint (transverse lines) (10)	41, 61	11.7	7.7
	42, 62	8.3	5.4
	43, 63	3.8	3.8
	44, 64	16.8	9.7
	45, 65	13.8	7.8
	46, 66	13.8	8.0
	47, 67	16.4	8.7
	48, 68	15.1	10.0
Beads in paint (transverse lines) (10)	49, 69	6.2	5.1
	50, 70	6.3	5.3
	51, 71	14.4	9.5
Beads on paint (longitudinal lines) (5)	81	20.6	11.8
	82	20.0	10.0
	83	10.2	4.9
	84	19.9	12.4
	85	16.6	10.0
	86	16.0	10.8
	87	18.7	12.1
	88	23.5	15.0
Beads in paint (longitudinal lines) (10)	89	6.0	5.5
	90	10.6	7.0
	91	14.6	10.5

Section "H"—Field Test

Type of Paint	Line Numbers	Hunter Meter Readings	Minn. M&M Photometer Readings
Beads on paint (transverse lines) (10)	1, 11	11.8	6.2
	2, 12	16.9	9.9
	3, 13	7.8	5.3
	4, 14	18.7	11.7
	5, 15	16.8	10.0
	6, 16	18.5	12.8
Beads in paint with beads on paint (transverse lines) (10)	7, 17	19.1	12.1
	8, 18	25.3	16.3
Beads on paint (longitudinal lines) (5)	21	11.1	6.3
	22	30.2	10.8
	23	4.9	5.6
	24	24.9	12.6
	25	20.3	10.7
	26	18.5	10.4
Beads in paint with beads on paint (longitudinal lines)	27	20.5	11.8
	28	23.9	14.6

Laboratory Panels

Standards	Panel Numbers	Hunter Readings	Minn. M&M Photometer Readings
Hunter values are avg. of six observers' readings	1	34.2	18.5
	2	43.6	20.0
	3	26.5	19.5
	4	19.9	13.0
	5	0.47	1.0
	6	0.90	1.8

Vibrations in Railroad Freight Cars

By S. G. Guins[1] and J. A. Kell[1]

ONE of the most important things that a packaging engineer must know is what it is that he is packaging against. The data that have been available to him up to now covered mostly shocks or impacts, while the field of vibration was an unknown quantity. Yet we know that when we submit the package to vibration tests, the damages are reduced considerably.

This is why we are particularly anxious to present the data on vibrations in freight cars obtained by measurements in actual cars by test engineers of the Chesapeake and Ohio Railway in cooperation with the Association of American Railroads and railway truck manufacturers. The test conditions were ideal as they permitted selection of typical trucks and then testing them under three load conditions of 60,000, 145,000, and 169,000 lb., and with a speed range of from 30 to 90 mph.

The instruments used to measure accelerations were chosen on the basis of availability. They consisted of two Statham 6 *g* accelerometers, a Hathaway MRC-12 5000-cycle carrier system amplifier and a Heiland A 401 R oscillograph recorder. The calibration for this entire system is shown on Fig. 1. All equipment worked satisfactorily.

We also had available two reed gages supplied by the Signal Corps., Dept. of the Army. Due to various changes made in the gages, only one was used on most tests. It was fitted with reeds having the following characteristics;

Frequency	Sensitivity
1. 51 cps.	255 *g* per in.
2. 35.5 cps.	123 *g* per in.
3. 3.6 cps.	1.26 *g* per in.
4. 78 cps.	590 *g* per in.
5. 5.7 cps.	3.17 *g* per in.
6. 12 cps.	14 *g* per in.

Our purpose in using these devices was to determine whether or not it would be possible to devise a usable instrument for the measurement of shocks and vibrations which could be operated by itself for long periods of time. The reason a reed gage would be a usable instrument is due to the fact that it gives, in a completed form, an analysis of the response of a single degree of freedom system to the vibration. A single degree of freedom system is simply a mass and a spring with some amount of damping. A box car, for example, mounted on springs, is a single degree of freedom system. Packages can be reduced to the same type of system within limits. Therefore, if this device were usable, it would be an analysis of the vibrations that would be felt by an article in a package.

As these particular instruments were constructed originally, the paper speed was very fast and variable. By slowing the paper speed down considerably a readable record was secured. Several

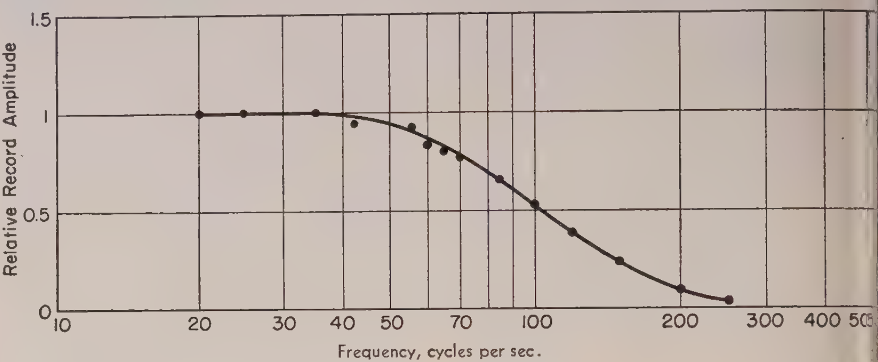


Fig. 1.—Calibration of 6G Accelerometer Type A8-6-120 Serial No. 5 with Hathaway MRC-12 and Heiland Type C Galvanometers.

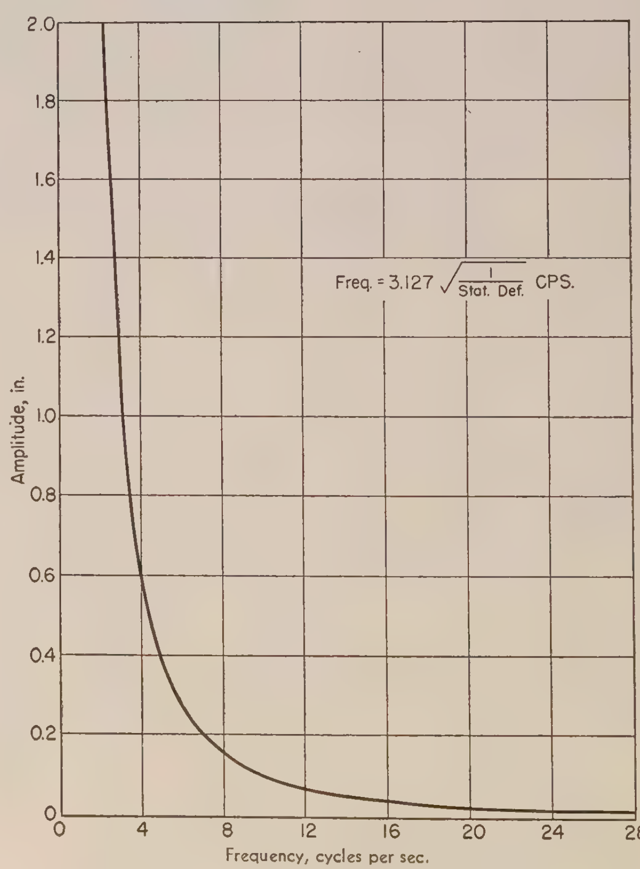


Fig. 2.—Frequency *versus* Static Deflection.

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[1] Research Engineer and Analysis and Test Engineer, respectively, Office of Research Consultant, The Chesapeake and Ohio Railway Co., Cleveland, Ohio.

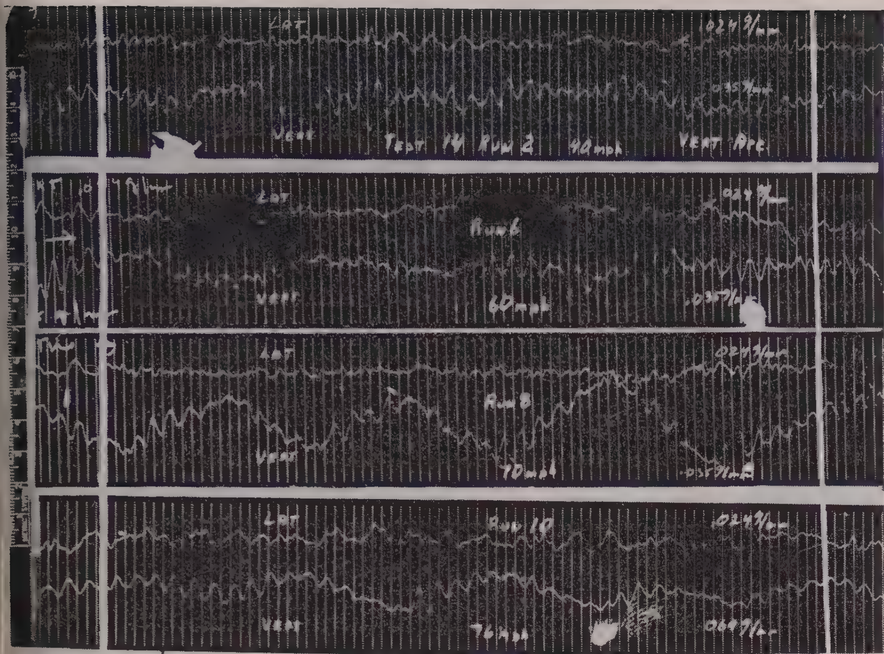

Fig. 3.—Typical Vibrations in Freight Cars.

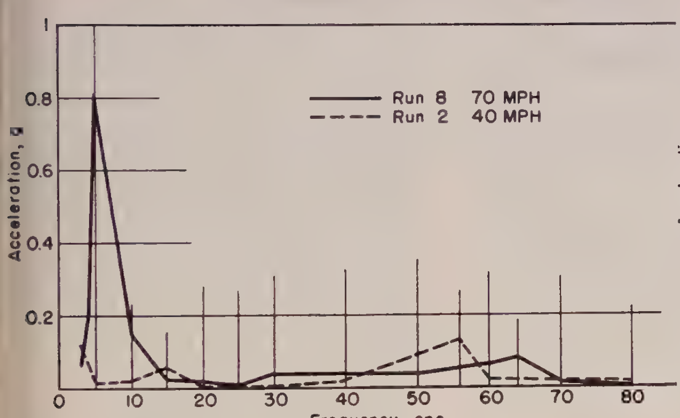

Fig. 4.—Harmonic Analysis of Test 14.

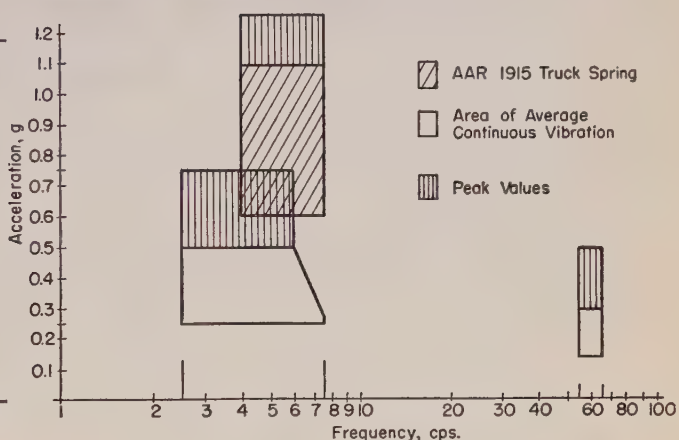

Fig. 5.—Summary of Data on Vibrations in Railroad Freight Cars.

other factors appeared, however, which affected the utility of these gages. First of all, the readability of the records decreases with frequency, and as seen from Fig. 2, a limit of about 20 cps. for a reading accuracy of 1 "*g*" is indicated. Secondly, at low frequencies, such a large deflection is secured when the reed is excited that the instrument becomes bulky due to the size of the table required in order to keep the reeds separated, indicating a low frequency limit of about 5 cps. It appears, therefore, that the reed gage will make an acceptable instrument for measuring road shocks, provided the user is only interested in frequencies between 5 and 20 cps.

Figure 3 gives a sample of the data obtained from the accelerometers during one of the tests, while Fig. 4 gives a harmonic analysis of the data in Fig. 3. Examination of Fig. 4 shows the presence of high acceleration at low frequency and a secondary peak around 60 cps.

Figure 6 is another example of car vibration, indicating resonance in the truck between 60 and 70 mph.

Figure 5 is the summary of all the tests. The fact of greatest interest is that the values of peak accelerations at all low frequencies are the same. The reason for the narrow range of frequencies is that the exciting frequencies, as indicated by Fig. 7, fall in the range of low frequencies, and the natural frequencies of suspension are in the same range. The higher frequency range is the range of structural vibrations. Figure 5 shows that A.A.R. 1915 trucks, which are still under half the box cars, cause much higher accelerations in the low frequency range than the cars with modern trucks.

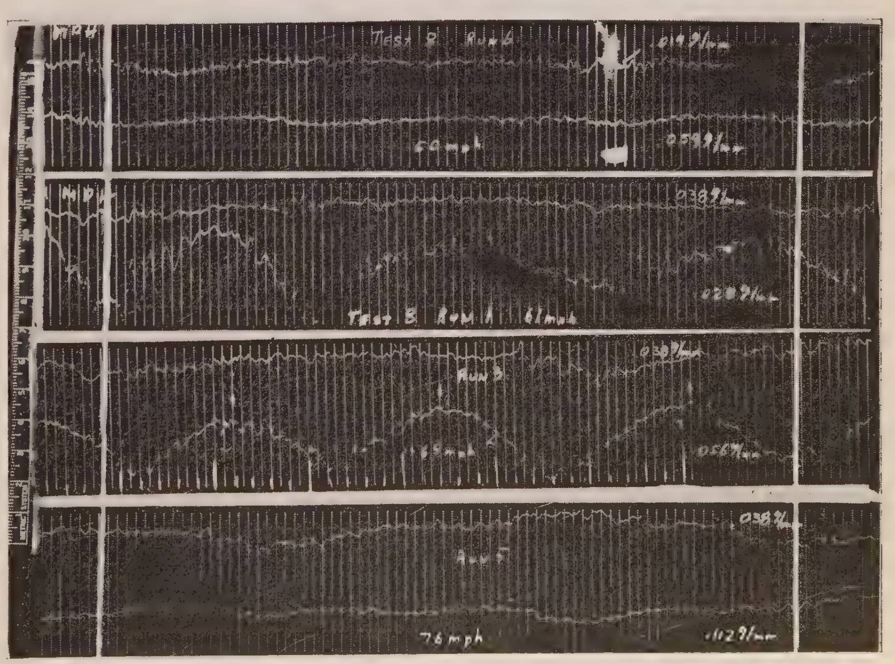

Fig. 6.—Example of Truck Going Through Resonance.

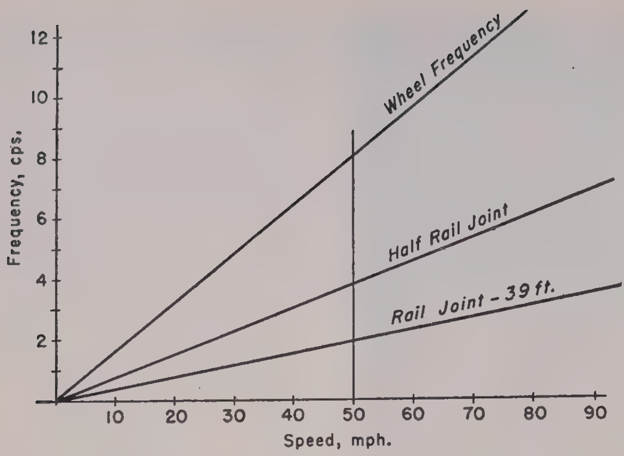

Fig. 7.—Forcing Frequencies Acting on Suspension of Freight Car.

Based on data of Fig. 5, we feel that the vibration test machines should be changed so that they would produce a constant acceleration of about $1^1/_8$ *g* for the frequencies ranging from 2.5 to 7.5 cps. Duration of the test should be such that the article is submitted to an equal number of cycles at each frequency (for example, 100 cycles), and the complete test need not exceed one hour. Based on Signal Corps tests data, highway trucks have the same general range of frequencies and acceleration as the ones reported above. A package that passes this test therefore, will not be damaged by vibrations in a railroad car truck.

The Izod Impact Test

A Study of the Sources of Variability When Testing Styrene and Other Plastic Materials by ASTM D 256 – 47 T, Method A[1]

By C. H. Adams[2]

Synopsis

The object of this investigation was to study the known sources of variability in the Izod impact method when testing styrene, cellulosic, and phenolic plastic materials.

The variables studied were (1) vise gripping pressure, (2) notch cutting tool radius and magnification under which it is measured, (3) depth of material under the notch, (4) lathe on which notching is done, and (5) molding conditions. Styrene plastic was the only material in which the effect of all of the above was studied. In the case of the phenolic and cellulosic plastics, vise gripping pressure was the only variable studied.

The conclusions reached upon the completion of this work, and which refer to styrene plastic unless otherwise indicated, are as follows:

1. Vise gripping pressure has a significant effect on the Izod impact strength of styrene plastic. It has little to no effect on phenolic (general purpose wood flour filled) or cellulose acetate materials.
2. Variation of the notch radius within the limits specified by ASTM Methods D 256 – 47 T has a significant effect on Izod impact strength, that is, larger radius causes higher apparent strength.
3. A magnification of at least 55 diameters is desirable to check the radii of cutting tools.
4. Variation in the depth of material under the notch outside the limits specified by ASTM Methods D 256 – 47 T has a significant effect on the Izod impact strength, that is, decreased depth causes less apparent strength.
5. No significant effect was apparent due to the use of two different lathes for notching.
6. No significant effect was apparent due to variation in molding conditions for the ½ by ½-in. cross-section specimens.

The Izod impact test is a widely used and accepted method for determining the "toughness" of plastic materials. The data so obtained serve to aid in product quality control, application and design work, research, and development. It has long been recognized that extreme care must be exercised in the preparation and testing of specimens if meaningful data are to be obtained.

It became apparent some time ago that styrene plastic was particularly sensitive to minor variations in testing procedure. At that time, the impact strength values for this material were subject to rather pronounced changes in level. The evidence available indicated that other properties were not fluctuating during this period. It seemed reasonable, therefore, to conclude that the variability was associated with the technique of sample preparation and testing.

Added impetus was given to this investigation by the low order of reproducibility attained among laboratories in round-robin test programs using the Izod method on other materials, notably phenolic.

Experimental

All styrene plastic specimens excep as noted were prepared from injection molded 5 by ½ by ½-in. bars. A stand ard molding condition was establishe and used except where the effect o molding conditions was studied. Th phenolic and cellulose acetate speci mens were prepared from compression molded 5 by ½ by ½-in. bars. Mold ing in these cases was done in accordanc with standard practice. The styren material conformed to type 1 as liste in ASTM Specifications D 703 – 49 T[3] The phenolic conformed to type 2 o ASTM Specifications D 700 – 49 T[4] woo flour filled type. The cellulose acetat was a medium-hard grade (grade 2 o ASTM Specifications D 706 – 48 T)[5]

Due to the difficulty of measurin actual vise-gripping pressure, a second ary control was employed. This wa accomplished through the applicati

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[1] Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256 – 47 T), 1949 Book of Standards, Part 6, p. 131.

[2] Research Dept., Plastics Div., Monsanto Chemical Co., Springfield, Mass.

[3] Tentative Specifications for Polystyrene Mo ing Compounds (D 703 – 49 T), 1949 Book ASTM Standards, Part 6, p. 476.

[4] Tentative Specifications for Phenolic Moldi Compounds (D 700 – 49 T), *Ibid.*, p. 19.

[5] Tentative Specifications for Acetate Moldi Compounds (D 706 – 48 T), *Ibid.*, p. 487.

TABLE I.—EFFECT OF VARIATIONS IN APPLIED TORQUE (VISE SCREW) STRENGTH.

Material Tested	Izod Impact Strength, ft-lb. per in. Notch			
	1 in-lb.	5 in-lb.	10 in-lb.	15 in-lb.
Styrene (general purpose crystal)	0.278 ± 0.055	0.264 ± 0.049	0.236 ± 0.050	0.204 ± 0.037
	(trend significant at better than 99 per cent level)			
Cellulose acetate (MH crystal)	1.609 ± 0.309	1.434 ± 0.258	1.473 ± 0.298	1.362 ± 0.304
	(difference between 1 and 15 in-lb. significant at 90 per cent level)			
Phenolic (general purpose wood flour filled)	0.310 ± 0.030	0.318 ± 0.023	0.322 ± 0.031	0.304 ± 0.027
	(no trend)	(no trend)	(no trend)	

of a known torque to the vise tightening screw.

Notching was done on a 6-in. lathe with a milling tool attachment holding a single tooth cutter. The peripheral speed of the cutter was 275 ft. per min. and the work was fed into the cutter at 1 ft. per min. The notch was cut with a silicon carbide tipped tool that had been ground with a diamond hone to the prescribed radius and recommended end clearance angle. The radius was checked against a standard with a microscope having a *camera lucida* attachment. The depth of the notch was checked by means of an ordinary screw micrometer with a notch contour attachment.

Testing was carried out on the Baldwin-Southwark Izod impact apparatus (Western Electric design) set to apply a maximum energy load of 2 ft-lb. This instrument was calibrated shortly before the tests, in accordance with ASTM Methods E 23 - 47 T[6] and instructions from the manufacturer. Tests were carried out at 23 C. and 50 per cent relative humidity.

Discussion

The Izod test has been the subject of numerous investigations, most of which have been devoted to a study of the theoretical aspects of the method.[7,8,9] These works have added a great deal to the knowledge on impact testing. The stated purpose of this paper, however, is to point out certain practical difficulties encountered in obtaining reproducible Izod data on plastic materials. It is recognized that many,[7] if not all, of the sources of variation described have been known to individuals concerned with this method for some time. However, it is felt that the results of a systematic study of the Izod method such as this should be made available to industry with the hope that further refinements in technique will be stimulated to the end of appreciably lowering the variability associated with the method.

The variables chosen for study were: (1) vise-gripping pressure, (2) notch cutting tool radius and magnification at which it is checked, (3) depth of material under notch, (4) effect of two different lathes, and (5) effect of molding conditions. Throughout the work all experimentation was based on statistical principles of design and analysis.

The effect of vise-gripping pressure was studied at four levels, namely, 1, 5, 10, and 15 in-lb. torque on the vise screw. The data obtained are given in Table I. It will be noted that styrene shows a consistent decrease in impact strength with increasing torque. As a matter of interest, the specimen is just barely held in the vise when a torque of 1 in-lb. is applied, that is, it is light

[6] Tentative Methods of Impact Testing of Metallic Materials (E 23 - 47 T), 1949 Book of ASTM Standards, Part 1, p. 1287.

[7] R. Burns and W. W. Werring, "The Impact Testing of Plastics," *Proceedings*, Am. Soc. Testing Mats., Vol. 38, Part II, p. 39 (1938).

[8] D. Telfair and H. K. Nason, "Impact Testing of Plastics—I. Energy Considerations," *Proceedings*, Am. Soc. Testing Mats., Vol. 43, p. 1211 (1943).

[9] C. R. Stock, "A Ball Impact Tester for Plastics," ASTM Bulletin, No. 130, October, 1944, p. 21.

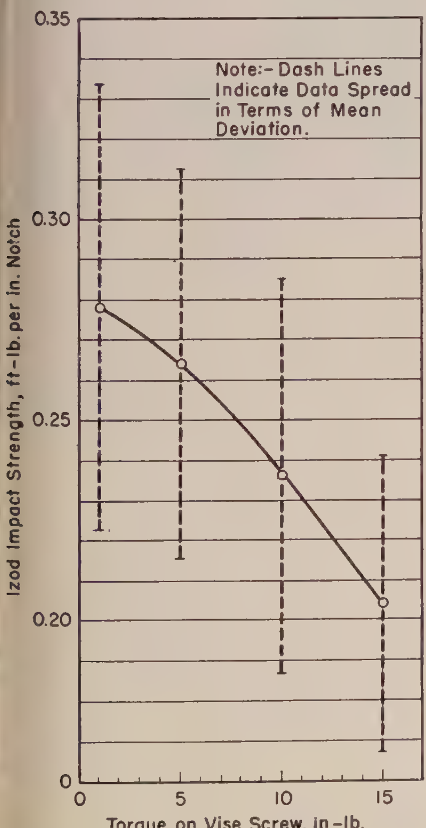

Fig. 1.—Correlation of Izod Impact Strength and Vise-Gripping Pressure For Styrene Plastic.

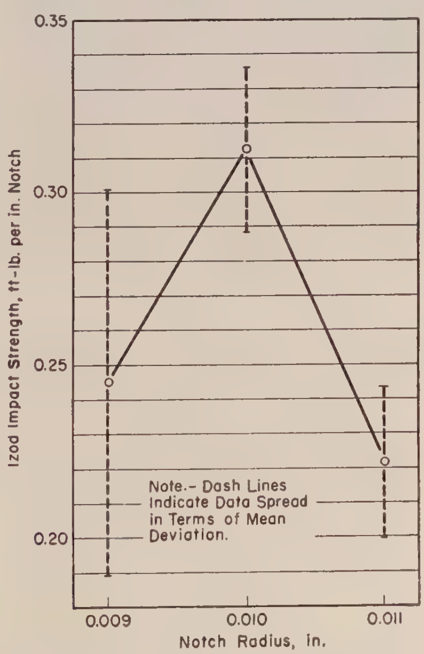

Fig. 2.—Plot of Izod Impact Strength *vs.* Notch Radius For Styrene Plastic.

(Notch radius examined at magnification of 42 ×.)

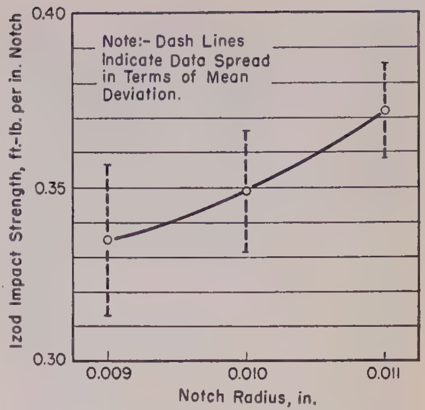

Fig. 3.—Correlation of Impact Strength and Notch Radius for Styrene Plastic.

(Notch radius examined at magnification of 57.5 ×.)

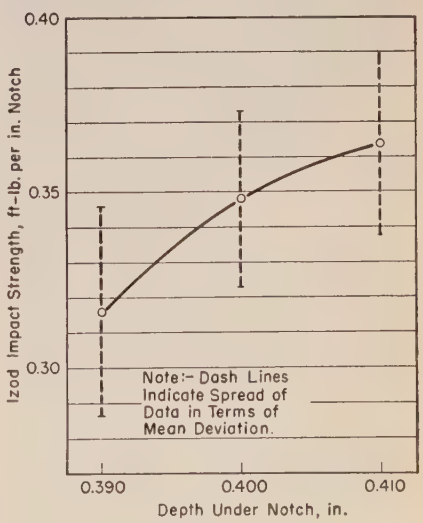

Fig. 4.—Correlation of Izod Impact Strength and Depth Under Notch for Styrene Plastic.

finger pressure tight. The cellulose acetate data show a significant difference to exist between the 1 and 15 in-lb. torques. A phenolic specimen does not seem to be sensitive to this variable. The data for styrene plastic given in Table I are shown plotted in Fig. 1.

The effect of varying notch cutting tool radius within the tolerances specified in ASTM Methods D 256[1] was then investigated for styrene. Three cutting tools were ground to 0.009, 0.010, and 0.011 in., respectively, being checked for contour at 42 × magnification. The specimens were then notched with these tools and tested (torque on vise screw 5 in-lb.). The results of this series are shown plotted in Fig. 2. It is readily apparent that no regular trend is established by these data. Based on these results, it was concluded that there were imperfections in the cutting tools (improper contour or nicks) not visible at 42 × magnification which were responsible for the erratic results. Accordingly, the work was repeated except that the cutting tools were examined at 57.5 ×. The test data from this series are more consistent with the results expected (see Fig. 3). There is a regular trend upward in impact strength with increase in notch radius. Two conclusions apparent from this portion of the work are that the cutting tool (or notch in specimen) should be examined for contour at fairly high magnification (55 to 60 ×) and that the tolerance on notch radius should be reduced to ±0.0005 in.

The next variable studied was depth of material under the notch, with styrene again the subject material. The depth was varied from 0.390 to 0.410 in. The data obtained are shown plotted in Fig. 4. The trend is in the expected direction. The notch radius for this series was 0.010 in., the cutting tool was examined at 57.5 ×, and the vise screw was tightened with an applied torque of 5 in-lb.

Two lathes were used in notching samples of styrene; all other factors were eliminated so far as possible. The test data indicated that the use of two lathes and the unknown factors were not a source of variability.

The study of the effect of injection molding conditions on impact strength is still under way. However, from present indications, again with styrene as the subject material, the $\frac{1}{2}$ by $\frac{1}{2}$-in. cross-section specimen is but slightly affected by rather drastic changes in molding conditions. The $\frac{1}{2}$ by $\frac{1}{8}$-in. specimen is, however, appreciably affected by these same changes. Further, one end of the 5-in. bar from which the samples are prepared has an impact strength higher than that of the other. The ends will be referred to as "gate end" and "dead end" (the end opposite the gate). It will be noted from Table II that the gate-end values are the higher ones.

TABLE II.—EFFECT OF HEATER TEMPERATURE AND CYCLE TIME IN MOLDING[a] ON IZOD IMPACT STRENGTH OF $\frac{1}{2}$ BY $\frac{1}{8}$-IN. SPECIMENS OF STYRENE PLASTIC.[b]

Bar Tested	Impact Strength, ft-lb. per in. Notch			
	Heater Temp., 375 F.		Heater Temp., 475 F.	
	Cycle, sec., 60/15/15	Cycle, sec., 15/60/15	Cycle, sec., 60/15/15	Cycle, sec., 15/60/15
Gate end	0.814	0.667	0.686	0.448
Dead end	0.479	0.426	0.447	0.448

[a] Mold pressure, 600 psi.; die temperature, 100 to 104 F.
[b] ASTM D 703, type 1, crystal.

Conclusions and Recommendations

Vise-gripping pressure has a marked effect on the Izod impact strength of styrene plastic materials. In general, when the specimen is held loosely the impact values are at a maximum. Cellulose acetate plastic of the MH formulation tested is but little affected by this variable. Phenolic plastic appears to be completely insensitive to how tightly it is held in the grip. It is recommended that provision be made to bring the vise-gripping pressure to a fixed constant value. Redesign of the grip may be necessary.

Notch radius is an important factor which requires control within rather close limits for styrene. In order to achieve the degree of control desired, the notching tool (or the notch) must be examined for proper contour at a magnification such that imperfections can be located. It is felt that the tolerances on notch radius should be lowered to ±0.0005 in. and that the notch should be examined under a magnification of at least 55 diameters.

The depth of material under the notch has an important effect on the impact strength of styrene materials. But the present recommended tolerance of ±0.002 in. on this dimension is satisfactory.

Notching on two different lathes had no effect on the impact data obtained. This obvious result is to be expected unless the machine tools used for notching are in poor condition.

Injection molding conditions have little effect on the Izod values obtained with styrene when a $\frac{1}{2}$ by $\frac{1}{2}$-in. specimen is used. It is important to note that it makes no difference which end of the 5 by $\frac{1}{2}$ by $\frac{1}{2}$-in. bar is used t obtain Izod data. Such is not the case when 5 by $\frac{1}{2}$ by $\frac{1}{8}$-in. bars are used. Further, these smaller samples are affected by changes in molding conditions. It is recommended that $\frac{1}{2}$ by $\frac{1}{2}$-in cross-section specimens be used wherever possible.

Acknowledgment:

The author is appreciative of the assistance of H. S. Lockwood and J. McMillan who carried out much of th experimental work. He is also indebte to E. C. Harrington, Jr., whose guidan in statistical design and computati were of invaluable aid.

The encouragement and support N. N. T. Samaras and H. W. Mohrm in carrying this work to its successf conclusion are gratefully acknowledge

Thanks are due to L. W. A. Meyer Tennessee Eastman Corp. for supplyin the cellulose acetate plastic used in th investigation.

Discussion of the Paper on Method of Test for Specific Heat[1]

Messrs. Edwin J. Callan[2] and Leonard Pepper.[3]—In the course of investigations regarding the thermal properties of blends of natural and portland cements, it became necessary to develop an accurate method for determining specific heats of these cement blends and pastes made therefrom. Since the procedures developed are quite similar in principle to those of the paper, it is felt that a relatively detailed description of the variations will be of interest in the evaluation of the proposed method of test.

The apparatus selected for use was basically the same as that described in the paper. Since the range of temperatures used in the work was between 5 and 27 C., which is lower than that us in the work reported in the paper, heating oven was necessary. Specically, the apparatus used was the stanard calorimeter specified in AST Standard Method of Test for Heat Hydration of Portland Cement 186 – 49).[4] This apparatus is very suable for specific heat determinatio It is felt that the use of standard aparatus is of considerable value in i

[1] N. H. Spear, "A Proposed Method of Test for Specific Heat of Thermal Insulating Materials," ASTM Bulletin, No. 168, September, 1950, p. 79 (TP 207).

[2] Physicist, Head, Thermal Research and Field Durability Section, Concrete Research Division, Waterways Experiment Station, Jackson, Miss.

[3] Chemist, Head, Chemistry Section, Concrete Research Division, Waterways Experiment Station, Jackson, Miss.

[4] 1949 Book of ASTM Standards, Part 3 118.

TABLE I.—CALIBRATION OF SPECIFIC HEAT APPARATUS.

Materials	Number of Tests	Mass of Specimen (Range, g)[a]	Mass of Medium (Range, g)	Temperature Changes (Range, deg Cent.)		C_p of Specimen
				Drop in Specimen	Rise in Medium	
Ottawa sand in H_2O	10	103.802 to 122.354	378.524 to 393.928	17.09 to 19.61	0.824 to 1.003	0.175[b]
Ottawa sand in kerosine	10	89.408 to 138.947	308.972 to 314.409	15.14 to 18.07	1.488 to 2.443	0.470 ± 0.003[c]
C_p ZnO in kerosine	3	123.669 to 145.260	309.753 to 313.646	15.40 to 16.40	1.461 to 1.589	0.117 ± 0.001[d]

[a] Ranges given are extreme ranges of all tests.
[b] C_p of Ottawa sand taken as 0.175 to obtain value of 18.41 ± 2.91 g as water equivalent of calorimeter, which value was used for all other tests.
[c] C_p given is that for kerosine.
[d] Interpolated handbook value of C_p for ZnO at 20 C. is 0.117.

TABLE II.—RESULTS OF SPECIFIC HEAT DETERMINATIONS OF CEMENT BLENDS.

Cement Blend[a]	Number of Tests	Mass of Specimen (Range, g)	Mass of Medium (Range, g)	Temperature Changes (Range, deg Cent.)		C_p of Cement Blend
				Drop in Specimen	Rise in Medium	
100% portland cement	3	75.353 to 85.830	315.096 to 318.009	24.44 to 25.36	2.119 to 2.339	0.183 ± 0.002
100% natural cement	3	53.462 to 65.921	310.309 to 315.690	17.50 to 18.07	1.211 to 1.491	0.208 ± 0.003
25% natural + 75% portland cement	3	62.661 to 66.520	311.243 to 317.589	15.24 to 19.19	1.075 to 1.441	0.186 ± 0.001
35% natural + 65% portland cement	3	63.628 to 69.618	313.100 to 314.913	17.73 to 19.20	1.343 to 1.463	0.194 ± 0.001
50% natural + 50% portland cement	4	19.696 to 69.171	306.952 to 314.821	18.06 to 19.24	0.458 to 1.552	0.195 ± 0.003

[a] Percentage compositions are by volume.

proving reproducibility of tests among laboratories. In the work performed at this laboratory, the materials were tested in a finely divided state, not encapsulated. The masses of specimens were considerably greater than those mentioned in Table I of the paper in order to provide adequate temperature rise. In our calorimeter the liquid medium (either water or kerosine) is added in amounts between 375 and 400 ml so as to cover the mercury well of the Beckmann thermometer. The final volume after addition of the sample is approximately 425 ml, in agreement with the statement in the paper that the depth level within the calorimeter must be kept constant. The material chosen as standard was graded, oven-dry, Ottawa sand with the mean specific heat between 0 and 25 C. taken as 0.175. This temperature range is that within which the tests were conducted. Zinc oxide was used as a secondary standard in confirming the value of specific heat for Ottawa sand, and the values for the water equivalent of the calorimeter and the specific heat of kerosine which were determined using the Ottawa sand.

The procedures used were similar to those of the paper with the principal exception that temperature readings were taken at 0.2-min intervals for the first minute[5] after addition of the sample and then at 1-min intervals until the rate of temperature rise was again constant to at least 0.001 C. for three successive readings. The calculations of specific heat are performed in accordance with the general pattern of those specified in the paper, with the temperature rise computed in accordance with the calculations given in ASTM Method C 186. Since the corrections to the observed temperature rise are approximately constant, the percentage errors diminish with increasing temperature rise. Therefore the sample size was chosen so as to give the greatest temperature rise for the allowable volume variations in the apparatus.

The results of calibration tests on the apparatus described above are given in the accompanying Table I. The value of 2.91 g is the standard deviation of the values of water equivalent and is relatively minor, yielding a variation in specific heat of materials tested of not more than 0.003. The experimental mean value for specific heat of zinc oxide (C_p) of 0.117 in the temperature range 7 to 25 C. compares excellently with the reported values for this substance[6] of 0.114 at 0 C. and 0.129 at 100 C., the interpolated value of which at 20 C. would be 0.117.

Some representative results obtained on cement blends are given in the accompanying Table II. The good agreement between experimentally determined values and calculated specific heats of the blends is shown in the accompanying Table III. The accuracy attained is sufficient for most routine determinations.

TABLE III.—COMPARISON OF EXPERIMENTAL AND CALCULATED SPECIFIC HEATS.

Cement Blend[a]	C_p of Cement Blend	
	Experimental	Calculated[b]
25% natural + 75% portland cement	0.186	0.189
35% natural + 65% portland cement	0.194	0.191
50% natural + 50% portland cement	0.195	0.195

[a] Percentage compositions are by volume.
[b] Calculated values are based on C_p of 100 per cent portland 100 per cent natural cements given in Table II.

A comparison of the data given in the paper and in the preceding discussion tends to show that considerably greater accuracy can be achieved by a few simple modifications of the procedures described in the paper. The temperature rise should be increased, and temperature readings taken at shorter intervals after addition of specimens, in accordance with the references given above. The observed temperature rise should be accurately corrected for heat of stirring and heat leakage, since the method shown in Fig. 2 of the paper is correct only where the initial and final slopes of temperature rise are identical. It is suggested that greater accuracy may be attained by use of finely ground samples rather than through use of the capsule, since the possible errors involved in ascertaining the temperature and specific heat of the capsule magnify the errors in the computed specific heats of the samples. The effects of heats of wetting and of reaction can be made negligible for the samples used with proper choice of liquid medium.

MR. NORMAN H. SPEAR (*author's closure*).—Messrs. Callan and Pepper have discussed points of the proposed test which have been likewise considered in committee. These points generally lead to test refinements which were purposely sacrificed in the tentative test requirements in order to simplify and produce a more usable standard and to render the test more adaptable to standardization of other specific heat measurements. A revised test proposal accounts for some of these points and is being subjected to another series of round-robin tests. It is hoped that this revision will yield more satisfactory results which will be published for additional comment and elicitation of interest.

[5] Since 0.8 of the total temperature rise is normally attained in this work within 1 min after addition of the sample, it is necessary, in securing an accuracy of 1 per mille, to take at least 5 temperature readings within this period. See W. P. White, "The Modern Calorimeter," *Monograph No. 42*, Am. Chemical Soc., p. 54 (1928)

[6] "Handbook of Chemistry and Physics," 30th Ed., Chemical Rubber Publishing Co., Brooklyn, N Y., p. 1779 (1947).

Some Strength and Related Properties of Old-Growth Douglas Fir Decayed by *Fomes Pini*[1]

By J. R. Stillinger[2]

Approximately 189 billion board feet of the total 439 billion board feet of available merchantable timber in the Douglas fir region of Washington and Oregon is old-growth Douglas fir (*Pseudotsuga taxifolia* (Poir.) Britt.). Kirkland[3] asserted that the Douglas fir region's 9 million acres of old-growth timber are losing 3 billion board feet of timber annually from rot. In many localities in western Oregon and Washington, the loss from rot may be over half the gross volume of the stand. The average loss for the region is 17 per cent; 81 per cent of this loss is caused by the red ring rot *Fomes pini* (Thore) Lloyd.

The amount of old-growth Douglas fir in western Washington and Oregon and the high percentage of loss from decay presents a problem worthy of investigation. Some practicable method of estimating the percentage of decay in a single standing tree or at least in stands on limited areas should be found. The Oregon Forest Products Laboratory is now working on this aspect of the problem. Many defective or "cull" trees that contain sizable quantities of sound, high-quality wood are left in the forest because there is no reasonably accurate method of evaluating the amount of usable material in the tree.

Assuming that a satisfactory method of estimating the amount of decay in a tree or in stands on limited areas will be forthcoming, the next logical problem is to find satisfactory uses for the large volumes of decayed wood that will develop in the cutting of old-growth Douglas fir stands. Before new uses can be recommended, information about the important strength and related properties of the decayed wood must be obtained. Since *Fomes pini* causes the greatest volume of decay in old-growth Douglas fir stands, initial efforts have been concentrated on wood decayed by this fungus.

At the present time, large quantities of lumber containing various degrees and amounts of decay caused by *Fomes pini* are used in home construction for wall and roof sheathing and for subflooring. There is always a certain amount of skepticism among carpenters, contractors, and ultimate users when this type of material is used. During the years following the war, the demand for new home construction was such that large quantities of this material have been used, partly because of high lumber prices and partly because of shortages in lumber supply. To a certain extent this more or less forced use has been good, since many skeptics have been convinced that the material can be used for specific purposes without deleterious effects. The principal objections to its use may be summed up as (1) the material looks unsatisfactory and (2) no usable information is available for its strength and related properties.

Objectives

The objectives of the investigation were twofold: (1) to determine the feasibility and practicablility of visually segregating stages of the decayed wood and (2) to evaluate a few of the more important properties of old-growth Douglas fir wood containing decay produced by *Fomes pini*. Tests to be included in the study were static bending (center-point loading), compression parallel to grain, compression perpendicular to grain, shrinkage, hardness, and nail-holding power.

Visual Segregation Study

If the decayed wood cannot be differentiated visually into classes without too much overlapping among classes, it will be extremely difficult to establish grades or any means of classification that will be useful.

Approach Used in Establishing Classes of Material:

An attempt to classify the decayed wood according to the descriptive terms mentioned in current lumber grading rules[4] did not prove to be satisfactory because of the differences of opinion in interpreting the descriptions of decay classes.

After the modulus of rupture values had been computed for 143 static bending test specimens, four frequency distributions were made, using class intervals of 50, 100, 200, and 300 psi. It was expected that the frequency distribution would give some clue to class boundaries and might show a tendency for modulus of rupture values to group around average values within class boundaries. Each frequency distribution suggested different possible numbers of decay classes. Working with each distribution independently, the test specimens were separated on the basis of modulus of rupture values into the classes suggested by the frequency distribution. The test specimens in each class were carefully inspected for distinctive visual characteristics that might offer a basis for separating the material. It soon became apparent that too much overlapping existed for a number of decay classes greater than three. A simple descriptive key for three classes of decayed material was developed.

Developing the Classification Key:

The following classification key describes typical specimens found in the respective classes. It should be remembered that the specimens described in the key are not the only types that may be found for a given strength class but they represent a breakdown of the test material from one locality, namely Oakridge, Ore. Investigation of material from other areas in the Douglas fir region may produce additional types that would fall within these classes.

CLASSIFICATION KEY

Class I

White pockets entirely absent or few in number.

A. Sound material with no visible white pockets.
B. Stained material without any or with few small visible white pockets (5 to 10 per sq ft of surface area).
C. Numerous small white pockets on one or two sides of the piece without any or with few on the other sides (5 to 10 per sq ft of surface area).
D. Widely scattered small and medium white pockets (50 to 80 per sq ft of surface area).

Class II

White pockets readily perceptible to the naked eye.

A. Numerous small and medium white pockets widely scattered on sides.
B. White pockets large (40 to 120 per sq ft of surface area), widely scatter[ed]

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[1] This paper was presented at the Session on Wood held at the First Pacific Area National Meeting of the Society, San Francisco, Calif., October 10–14, 1949.

[2] Chief, Industrial Service Section, Oregon Forest Products Laboratory, Corvallis, Ore.

[3] Burt P. Kirkland, "Forest Resources of the Douglas Fir Region," Joint Committee on Forest Conservation, Portland, Ore., 1946.

[4] Standard Grading and Dressing Rules for West Coast Lumber, No. 14, West Coast Lumbermen's Assn., Portland, Ore., 1947.

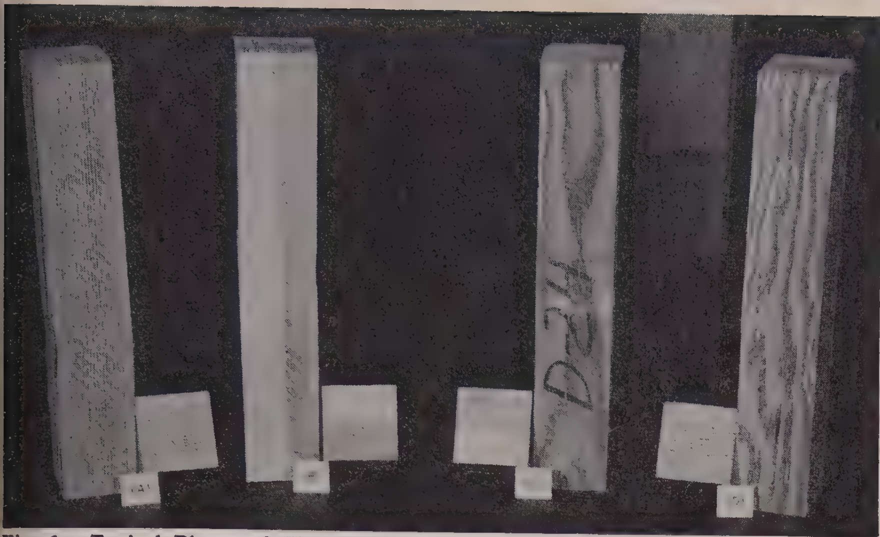

Fig. 1.—Typical Pieces of Class I Old-Growth Douglas Fir Decayed by *Fomes pini.*

CLASS III

Pockets with white fibers absent or not readily perceptible to the naked eye.

A. Large pockets usually without white fibers; many pockets widely scattered on all sides.
B. Numerous small and medium pockets; pockets quite close together with or without a few larger pockets interspersed.
C. Numerous elongated pockets giving the appearance of several smaller pockets run together.

Figures 1, 2, and 3 illustrate typical pieces for each decay class of old-growth Douglas fir decayed by *Fomes pini.* The letters *A*, *B*, *C*, and *D* in the illustrations refer to material fitting the classification key descriptions having the same alphabetical designations.

Reliability of Classification Key:

Six men were asked at different times to classify the 143 test specimens after all had been completely and thoroughly randomized. Considering the fact that most of the men had very limited experience with this type of material, the over-all average of 82 per cent for correctness in classification was encouraging. Thereafter, for all tests, the decayed wood was separated, prior to the physical testing, into the three classes described in the key.

EXPERIMENTAL PROCEDURE

Standard recommended procedures for testing small timbers[5] were carried out for the static bending and compression parallel and compression perpendicular to grain tests. All static bending specimens were tested in the green condition; that is, above the fiber-saturation point (approximately 30 per cent moisture content). The two compression tests and the hardness test included material in the green and dry (12 per cent moisture content) conditions. Because greater variation was expected as a result of the presence of decay, the number of hardness penetrations in each test surface was increased to four in order to give more reliable average values. The size of shrinkage specimens was not standard. Vertical-grained 2 by 2 by 6-in. test specimens were selected to minimize the distortion resulting from seasoning. Some of the specific gravity test blocks used in the static bending test were utilized for determining the radial, tangential, and volumetric shrinkage values for the decayed wood. Linear measurements were made to the nearest 0.001 in. at the green, 12-per cent, 6-per cent, and oven-dry moisture content levels.

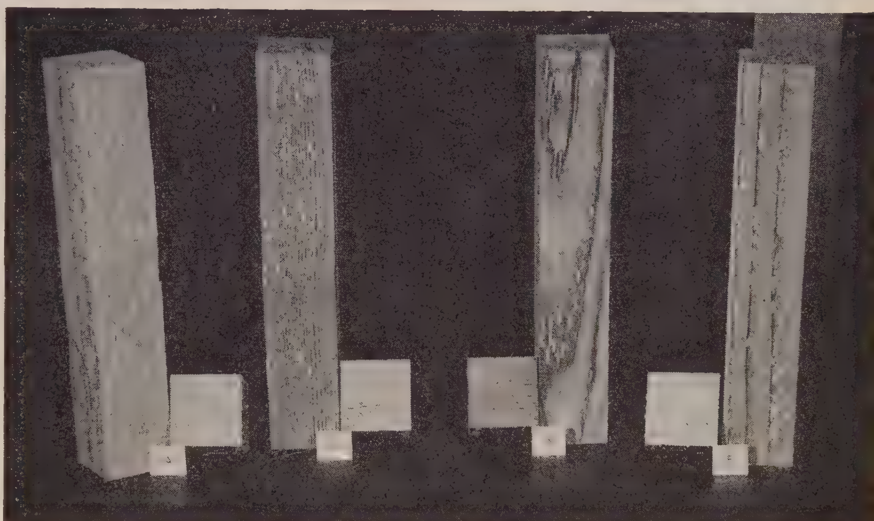

Fig. 2.—Typical Pieces of Class II Old-Growth Douglas Fir Decayed by *Fomes pini.*

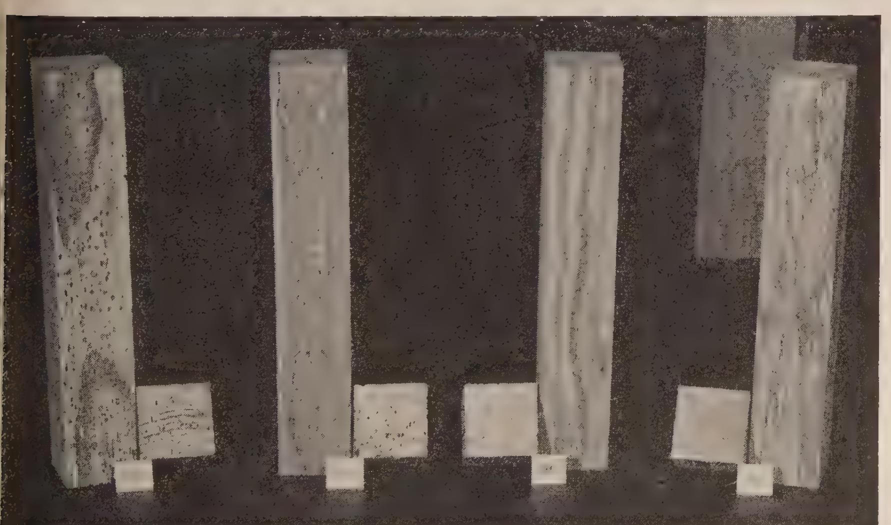

Fig. 3.—Typical Pieces of Class III Old-Growth Douglas Fir Decayed by *Fomes pini.*

RESULTS OF TESTS OTHER THAN NAIL HOLDING

The results of the static bending, compression parallel and compression perpendicular to grain, hardness, and

[5] Standard Methods of Testing Small Clear Specimens of Timber (D 143 –49), 1949 Book of ASTM Standards, Part 4, p. 617.

shrinkage tests on Douglas fir wood decayed with *Fomes pini* are given in Table I. The more important results from each type of test are briefly summarized in the following paragraphs.

Static Bending:

Modulus of rupture and stress at proportional limit values were reduced from those of sound wood approximately 12, 35, and 57 per cent for decay classes I, II, and III, respectively. The modulus of elasticity of class I material was not significantly different from that of sound wood, but the modulus of elasticity values for classes II and III were reduced about 21 and 45 per cent, respectively. The two work values, which are measures of shock resistance, suffered more critically than any of the other properties investigated. Work to proportional limit was reduced approximately 22, 49, and 66 per cent for classes I, II, and III, respectively, whereas work to maximum load was reduced, correspondingly, about 43, 67, and 81 per cent for the three decay classes. On a percentage basis, specific gravity was affected least, class I material showing no significant difference from sound wood and classes II and III revealing reduction of approximately 14 and 26 per cent, respectively. Since weight per cubic foot is a function of specific gravity, the densities of the three classes of decayed material will exhibit the same proportionate reductions at the oven-dry condition and lower percentage reductions at the 12 per cent moisture content condition (average for well air seasoned material) because of the adjustments for moisture and density.

Compression Parallel to Grain:

Maximum crushing strength was definitely reduced in green and dry material, the latter suffering the greatest percentage reductions. Reductions from sound wood values were 19, 35, and 56 per cent for the green and 37, 50, and 64 per cent for the dry material in classes I, II, and III, respectively. Stress at proportional limit was seriously reduced in green and dry material by approximately equal percentages in corresponding decay classes. Reductions were about 45, 56, and 68 per cent for classes I, II, and III, respectively.

The work of Scheffer, Wilson, Luxford, and Hartley[6] in 1941 does not provide a basis for direct comparison with the test data in Table I. Their results on Sitka spruce showed reductions of 30, 70, and 95 per cent, respectively, for specific gravity, maximum crushing strength in compression parallel to grain, and toughness for air-dry test material in the advanced stages of decay. For class III material in the air-dry condition, our results indicated specific gravity reductions of 22 to 28 per cent and a maximum crushing strength reduction of 64 per cent. Because a toughness tester was not available, work values from static bending were the only measures of toughness obtained. Green class III material showed a reduction of 81 per cent from the work to maximum load values for sound wood. No static bending tests were made on material in the air-dry condition. The foregoing comparisons of properties of Sitka spruce and Douglas fir seem to indicate that both species are affected similarly by the presence of *Fomes pini*. Without further study of both species, direct use of the comparative data cited would be somewhat hazardous.

Compression Perpendicular to Grain:

Results for the compression perpendicular to grain tests were based on 15 green and dry test specimens for each decay class, giving a total of 45 test specimens for each moisture condition. Stress at the proportional limit was more seriously affected in dry than in green material for all decay classes. Reductions were approximately 0, 12, and 48 per cent for green and 15, 32, and 62 per cent for dry material in classes I, II, and III, respectively. Compression (Table II) per unit of stress was smaller for dry than for green material. In green and dry material, the compression increased, progressively, from a minimum in class I to a maximum in class III.

A class by class comparison of the specific gravity values of specimens used in the compression perpendicular to the grain test with those of the static bending test shows a good correlation and suggests the possibility of obtaining reliable information from comparatively small numbers of test specimens if rigorous adherence to random selection is followed. Too much overlapping of stress values existed between decay classes I and II, which suggests the inadvisability of visual segregation, unless the class II average stress is used for both classes of material. This also leads to the conclusion that not all strength properties were affected in a like manner by the presence of the decay.

Hardness:

In all decay classes, with one exception (class III, radial surface), th

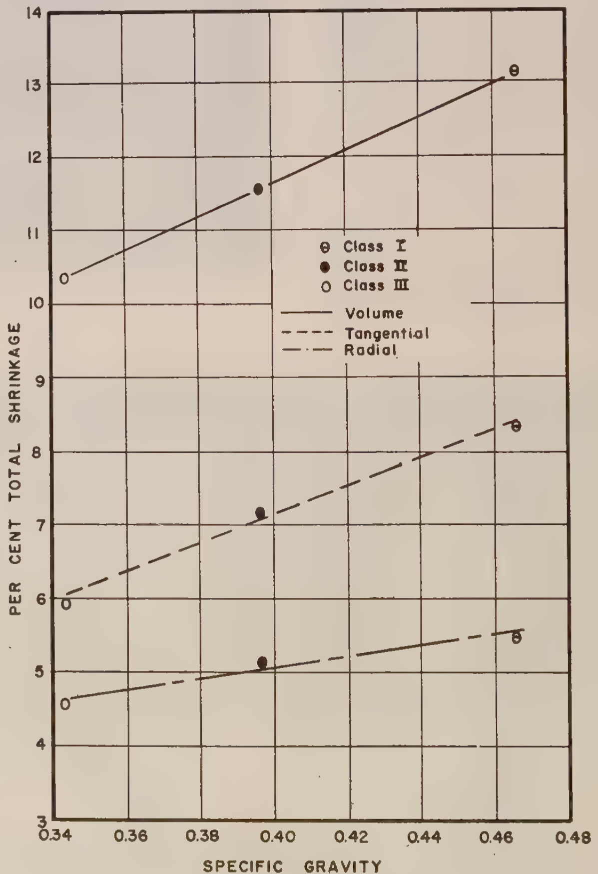

Fig. 4.—Specific Gravity-Shrinkage Relationship for Old-Growth Douglas Fir Decayed by *Fomes pini*.

[6] T. C. Scheffer, T. R. C. Wilson, R. F. Luxford, and Carl Hartley, "The Effect of Certain Heart Rot Fungi on the Specific Gravity and Strength of Sitka Spruce and Douglas-fir," U. S. Dept. of Agriculture *Technical Bulletin*, No. 779, May, 1941.

TABLE I.—AVERAGE STRENGTH AND RELATED PROPERTY VALUES, VARIABILITY, AND PER... (12 PER CENT MOISTURE CONTENT) OLD-GROWTH DOUGLAS FIR WOOD DECAYED BY *FOMES PINI*.

Decay Class	Moisture Condition	Statistical Factors[a]	Static Bending: Modulus of Rupture, psi	Static Bending: Stress at Proportional Limit, psi	Static Bending: Modulus of Elasticity, psi	Static Bending: Work, in.-lb per cu in., to Proportional Limit Load	Static Bending: Work, in.-lb per cu in., to Max Load	Static Bending: Specific Gravity	Static Bending: Calculated Weight per cu ft, lb[b]	Compression Parallel to Grain: Maximum Crushing Strength, psi	Compression Parallel to Grain: Stress at Proportional Limit, psi	Compression Parallel to Grain: Modulus of Elasticity, psi	Compression Parallel to Grain: Specific Gravity	Compression Perpendicular to Grain: Stress at Proportional Limit, psi	Compression Perpendicular to Grain: Compression at Proportional Limit Load, in.	Compression Perpendicular to Grain: Specific Gravity	Shrinkage, per cent: Radial	Shrinkage, per cent: Tangential	Shrinkage, per cent: Volumetric	Hardness, lb: Radial	Hardness, lb: Tangential	Hardness, lb: End
I	Green	Avg.	6891	4352	1 721 000	0.62	4.00	0.466	35.2	3290	1902	2 483 000	0.427	573	0.022	0.464	5.36	8.28	13.13	341	332	409
		n	28	28	28	28	28	28	28	5	5	5	5	15	15	15	14	14	14	40	40	40
		s	486	345	144 000	0.10	0.39	0.019	1.4	241	564	824 000	0.033	101	0.003	0.024	0.45	0.75	0.62	55	62	70
		Per cent std.	88	90	103	78	57	101	101	81	55	[c]	93	106	[c]	101	94	109	99	66	65	76
	Dry[d]	Avg.	...	...	...	...	...	...	...	6862	5157	2 985 000	0.453	1150	0.039	0.455	...	...	...	585	659	751
		n	...	...	...	...	...	...	...	8	8	8	8	15	15	15	...	...	...	40	40	40
		s	...	...	...	...	...	...	...	1176	1149	602 000	0.060	313	0.006	0.031	...	...	...	59	68	72
		Per cent std.	...	...	...	...	...	...	...	63	56	[c]	98	85	[c]	99	...	...	...	75	85	83
II	Green	Avg.	5109	3086	1 333 000	0.41	2.30	0.397	29.7	2677	1647	2 504 000	0.387	477	0.023	0.416	5.08	7.15	11.59	292	278	385
		n	34	34	34	34	34	34	34	16	16	16	16	15	15	15	13	13	13	40	40	40
		s	326	461	202 000	0.12	0.58	0.032	2.4	414	666	783 000	0.033	90	0.003	0.043	1.61	1.18	1.37	75	73	73
		Per cent std.	65	64	79	51	33	86	85	65	48	[c]	84	88	[c]	90	89	94	88	57	54	71
	Dry[d]	Avg.	...	...	...	...	...	...	...	5478	3657	2 494 000	0.410	926	0.037	0.403	...	...	...	500	560	633
		n	...	...	...	...	...	...	...	17	17	17	17	15	15	15	...	...	...	40	40	40
		s	...	...	...	...	...	...	...	1204	1114	712 000	0.045	197	0.005	0.032	...	...	...	52	55	44
		Per cent std.	...	...	...	...	...	...	...	50	39	[c]	89	68	[c]	87	...	...	...	64	72	70
III	Green	Avg.	3376	2037	917 000	0.27	1.35	0.343	25.4	1778	1093	1 589 000	0.332	279	0.021	0.358	4.49	5.92	10.34	238	210	266
		n	81	81	81	81	81	81	81	36	36	36	36	15	15	15	49	49	49	40	40	40
		s	616	500	178 000	0.10	0.49	0.035	2.6	371	314	517 000	0.033	89	0.005	0.043	1.02	1.49	0.53	65	64	68
		Per cent std.	43	42	55	34	19	74	73	44	32	[c]	72	52	[c]	78	79	78	78	46	41	49
	Dry[d]	Avg.	...	...	...	...	...	...	...	3479	3089	1 756 000	0.357	516	0.032	0.346	...	...	...	310	351	572
		n	...	...	...	...	...	...	...	25	25	25	25	15	15	15	...	...	...	40	40	40
		s	...	...	...	...	...	...	...	774	647	346 000	0.037	148	0.006	0.029	...	...	...	51	52	58
		Per cent std.	...	...	...	...	...	...	...	36	33	[c]	77	38	[c]	75	...	...	...	40	45	63

[a] n = Number of test specimens or points (hardness test). s = Standard deviation. Per cent std. = Percentage of sound wood (Lane Co., Ore.) values given in "Strength and Related Properties of Woods Grown in the United States," by L. J. Markwardt and T. R. C. Wilson, U. S. Dept. of Agriculture, *Technical Bulletin No. 479* (1935).
[b] Twelve per cent moisture content.
[c] No standard available for comparison.
[d] No static bending tests were made on dry (12 per cent moisture content) material.

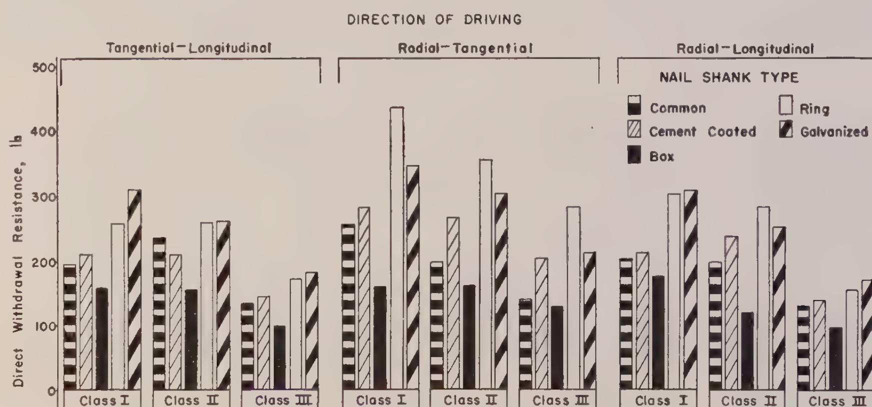

Fig. 5.—Average Direct Withdrawal Resistance of Different Shank Type 8d Nails Driven to a Depth of 1¾ in. (in Several Directions at a 45-deg Angle and Pulled Immediately) in Old-Growth, Green Moisture Condition Douglas Fir Decayed by *Fomes pini.*

hardness of green material was reduced more on a percentage basis than that of dry material. Both green and dry material indicated progressive reductions in hardness as the decay became more advanced; end hardness was affected less than that of the radial and tangential surfaces. The hardness of the tangential surface of dry material was less affected than that of the radial surface, whereas in green material the radial suffered slightly less hardness reduction than the tangential surface.

TABLE II.—COMPRESSION AT THE PROPORTIONAL LIMIT LOAD AND AT A CONSTANT LOAD OF 1000-LB FOR OLD-GROWTH DOUGLAS FIR DECAYED BY *FOMES PINI*.

Decay Class	Compression, in. (green)		Compression, in. (dry)	
	At Proportional Limit Load	At 1000-lb Load	At Proportional Limit Load	At 1000-lb Load
I . .	0.0219	0.0382	0.0385	0.0335
II . .	0.0225	0.0472	0.0372	0.0402
III . .	0.0209	0.0749	0.0321	0.0622

Shrinkage:

A summary of the shrinkage values obtained at various moisture content levels is presented in Table III, and the relationship between specific gravity and total shrinkage is illustrated in Fig. 4. A definite reduction in shrinkage, in progressing from class I to class III material, was found. Class III volumetric shrinkage was approximately 87 per cent of that for class I material in drying from the green condition to a moisture content of 6 per cent. A good linear relationship between specific gravity and the total shrinkage, expressed as percentages of the green dimensions, was found. This was not unexpected because sound wood with significantly different specific gravity values exhibits the same tendency.

TABLE III.—SHRINKAGE PERCENTAGES, BASED ON GREEN DIMENSIONS, FOR THE THREE CLASSES OF OLD-GROWTH DOUGLAS FIR DECAYED BY *FOMES PINI*, AT THREE MOISTURE CONDITIONS.

Measurement	Decay Class	Moisture Content, per cent		
		12	6	Oven-dry
Tangential . .	I	5.64	7.95	8.28
	II	4.65	6.77	7.15
	III	4.05	6.54	5.92
Radial	I	3.64	5.16	5.36
	II	3.04	4.82	5.08
	III	2.97	4.61	4.49
Volume	I	9.09	12.38	13.13
	II	7.68	11.30	11.59
	III	6.97	10.75	10.34

Nail-Holding Properties

There are many uses for wood that do not require strength as a primary requisite for satisfactory performance but which require of the wood the ability to resist forces tending to withdraw nails that are acting as the bonding agent between two contiguous members.

Scope of Tests:

The nail-holding study was divided into six major tests: (1) nails driven into green material and pulled immediately, (2) nails driven into green material and pulled after wood had seasoned to 12 per cent moisture content, (3) nails driven into 12 per cent moisture content material and pulled immediately, (4) nails driven into 12 per cent moisture content material and pulled after wood had seasoned to 6 per cent moisture content, (5) nails driven into 12 per cent moisture content material and pulled after the wood had been dried to 6 per cent and then conditioned to 16 per cent moisture content, and (6) nails driven at a 45-deg angle with the surface of green material and pulled immediately.

Material:

Test blocks were selected entirely at random, and 12 to 15 specimens were used for each test. Five shank types for 8d nails were used: common, cement-coated, box, ring, and galvanized.

Experimental Procedure:

The experimental work in each of the major nail-holding tests was divided into eight steps: (1) initial conditioning of test specimens, (2) marking the faces of each test specimen to designate driving locations for nails, (3) marking the proper depth of penetration on each nail shank, (4) randomizing of nails, (5) driving of nails, (6) conditioning test specimens before pulling nails, (7) pulling of nails, and (8) recording experimental data. Not all tests required these eight steps. Nails were extracted from the test specimens by using a pulling rate of 0.5 in. per min. A study of the effects of different testing machine head speeds showed that a speed of 0.5 in. per min gave average direct withdrawal values not significantly different from those obtained with head speeds ranging from 0.05 to 1.0 in. per min. A small vise with grooved jaws was used to hold the test blocks in the testing machine.

Results:

It is impossible to present all of the interesting details that were connected with each test of nail-holding properties, but many of the results are condensed in graphic and tabular forms of presentation. Table IV shows the effects of different moisture conditions, nail shank types, classes of material, and directions of driving on the direct withdrawal resistance of 8d nails, and Table V indicates the losses or gains in nail-holding power resulting from changes in moisture content of the wood. Figure 5 shows graphically the results for nails driven at a 45-deg angle.

Discussion:

It should be pointed out that the percentage values in Table V cannot be construed in any manner as a measure of nail-holding value in pounds, since each individual percentage value was determined from a different numerical base.

Like Table IV, Table V offers many individual and worth-while comparisons; however, only significant group comparisons will be made.

1. With one exception (cement-coated, class I, tangential), a greater percentage loss in holding power occurred in moisture change "B" than in moisture change "A". This is especially interesting, since a greater proportion of the total shrinkage in the test block occurred in seasoning from the green to a 12 per cent moisture content than in seasoning from 12 to 6 per cent moisture content. The resistance of the nail shank to the shrinkage of the wood around it causes a compression set in the wood, thereby decreasing the nail-holding power.

2. Inspection of Table V indicates that the withdrawal resistances of different nail shank types are not affected to the same extent. Certain shank types resisted loss in holding power following seasoning of the test blocks more than others. To summarize the effect of a change in the wood from a green condition to 12 per cent moisture content on nail-holding power, the resistance of the different nail shank types to loss in holding power was in the following order, the most resistant being listed first:

(*a*) Ring
(*b*) Galvanized
(*c*) Box
(*d*) Common
(*e*) Cement-coated

3. Where nails were driven into 12 per cent moisture content material and pulled after the wood had seasoned to 6 per cent moisture content, the resistance of the nails to loss in holding power took this order, the most resistant being listed first:

(*a*) Ring
(*b*) Galvanized
(*c*) Cement-coated and common
(*d*) Box

4. Another group comparison concerns the ability of nails to regain holding power by increasing the moisture content to swell wood that has been seasoned after the nails were driven. To explore this possibility, nails that were driven into test blocks having a moisture content of 12 per cent were pulled after the wood had

been allowed to season to a moisture content of 6 per cent and were then conditioned to a moisture content of 16 per cent. The abilities of the different nails to recover holding power were in the following order, the first listed having the best ability to do this:

(*a*) Box
(*b*) Common
(*c*) Galvanized
(*d*) Cement-coated
(*e*) Ring

The foregoing test consisted of a single drying and remoistening cycle, and it is recognized, of course, that after a series of such cycles the holding power of all nail types would probably be seriously reduced, particularly if the changes in moisture content were great.

Not much work has been done on the nail-holding power of old-growth Douglas fir decayed by *Fomes pini*. Some preliminary work has been accomplished by W. E. Bonser at the U. S. Forest Products Laboratory.[7] His material appeared to correspond to class II wood and had an average withdrawal resistance of 316 lb at a moisture content of 12.5 per cent and a side grain nail penetration of $1\frac{3}{4}$ in. This average was based on 63 nails; the comparable value for class II material, based on 12 nails, was 292 lb. Bonser's "*x*" grade that appeared to correspond to class III material indicated a withdrawal resistance of 200 lb, based on 81 nails; the comparable value for class III wood, based on 12 nails, was 185 lb.

[7] W. E. Bonser, "Adequacy of No. 3 Wood Framing and Sheathing in Conventional Wall Construction" (File report), U. S. Forest Products Laboratory, Madison, Wis., May 6, 1949.

Normal Variability:

In attaching confidence to the values in the tables in this report, normal expected variation should not be overlooked. A finished report would include a calculation of the least significant difference for each test; such a value depends on the variation found within each test and the number of test values. Generally speaking, the tests yielding the higher average withdrawal resistance values will also have the higher least significant differences because of greater numerical variation in the higher values. In most of the tests, a difference of approximately 30 lb between average values must occur before the range of normal expected variation is exceeded for a 0.95 probability; therefore, differences of less than 30 lb between average withdrawal resistance

TABLE IV.—COMPARISON OF DIRECT WITHDRAWAL RESISTANCE[a] OF DIFFERENT SHANK TYPES[b] OF THE 8d NAIL DRIVEN IN VARIOUS DIRECTIONS[c] UNDER SEVERAL MOISTURE CONDITIONS IN OLD-GROWTH DOUGLAS FIR DECAYED BY *FOMES PINI*.

Moisture Conditions of Nail-Holding Test	Direction of Driving[c]	Withdrawal Resistance, lb[a]														
		Class I Decay					Class II Decay					Class III Decay				
		C	Cc	B	R	G	C	Cc	B	R	G	C	Cc	B	R	G
Nails driven in green; pulled immediately	T	272	297	245	406	354	260	231	196	340	278	189	177	152	264	202
	R	270	301	242	400	322	264	212	212	356	271	200	161	158	262	190
	L	118	149	120	144	155	118	94	79	108	125	91	65	58	78	88
Nails driven in 12 per cent moisture content; pulled immediately	T	316	345	294	558	417	292	341	230	500	358	185	226	123	305	247
	R	371	473	289	594	494	292	374	218	508	452	166	242	118	338	228
	L	163	194	92	167	175	139	170	100	161	192	88	108	54	96	117
Nails driven in green; seasoned to 12 per cent moisture content; pulled	T	161	75	117	264	189	135	87	144	287	228	93	65	65	244	203
	R	126	101	97	370	258	123	116	128	398	263	115	80	119	333	226
	L	53	51	58	166	164	80	39	51	183	184	52	32	49	132	152
Nails driven in 12 per cent moisture content; seasoned to 6 per cent; pulled	T	69	123	69	216	133	71	65	47	179	122	52	57	29	177	110
	R	89	123	67	270	148	81	75	48	233	118	68	78	32	210	101
	L	22	52	22	45	39	12	33	11	46	51	15	31	11	46	40
Nails driven in 12 per cent moisture content; seasoned to 6 per cent; conditioned to 16 per cent; pulled	T	252	229	209	376	342	255	202	204	340	289	232	182	206	286	249
	R	323	304	307	471	337	288	257	262	369	341	233	179	232	306	275
	L	40	57	59	70	67	77	69	72	81	66	113	97	87	86	94

[a] Values are averages based on 12 to 15 individual test values.
[b] The shank types studied were common (C), cement-coated (Cc), box (B), ring (R), and galvanized (G).
[c] All nails were driven to a depth of $1\frac{3}{4}$ in. and values obtained for tangential (T), radial (R), and longitudinal (L) directions of driving in which the direction refers to the movement of the nail shank with respect to the annual rings in the wood.

TABLE V.—LOSS OR GAIN IN THE DIRECT WITHDRAWAL RESISTANCE OF DIFFERENT SHANK TYPE NAILS DRIVEN IN VARIOUS DIRECTIONS, UNDER SEVERAL MOISTURE CONDITIONS, IN THREE CLASSES OF OLD-GROWTH DOUGLAS FIR WOOD DECAYED BY *FOMES PINI*.

Direction of Driving[a]	Moisture Conditions of Nail-Holding Test[b]	Loss or Gain in Withdrawal Resistance, per cent[c]														
		For Decay Class I and Type of Nail Shank[d]					For Decay Class II and Type of Nail Shank[d]					For Decay Class III and Type of Nail Shank[d]				
		C	Cc	B	R	G	C	Cc	B	R	G	C	Cc	B	R	G
Tangential	A	41	75	52	36	46	49	61	26	16	18	50	62	56	6	0
	B	79	64	77	61	68	75	80	80	64	66	73	76	77	42	55
	C	21	34	30	33	19	12	41	10	32	19	+27	20	+68	7	+2
Radial	A	53	67	61	8	20	52	44	39	+12	4	44	52	26	+27	+19
	B	76	74	78	55	70	71	79	78	55	74	61	68	75	39	55
	C	13	36	+6	21	31	2	32	+19	28	25	+39	27	+95	9	+21
Longitudinal	A	55	65	51	+15	+5	32	59	34	+69	+47	43	51	17	+68	+72
	B	87	73	76	73	78	92	80	88	71	73	83	71	78	51	66
	C	75	71	36	58	62	45	60	28	48	65	+28	11	+62	11	20

[a] All nails were 8d, driven to a depth of $1\frac{3}{4}$ in. Direction refers to the movement of the shank with respect to annual growth rings.
[b] A = Nails driven into green material and pulled after the wood had dried to 12 per cent moisture content. B = Nails driven into material of 12 per cent moisture content and pulled after the wood had dried to 6 per cent. C = Nails driven into material of 12 per cent moisture content and pulled after the wood had dried to 6 per cent and was then conditioned to 16 per cent.
[c] The average withdrawal resistance of nails driven into green material and pulled immediately was taken as the comparative base for determining the percentage loss or gain in withdrawal resistance for the "A" moisture condition. Similarly, the average withdrawal resistance of nails driven into wood at 12 per cent moisture content and pulled immediately was used as the base for the "B" and "C" moisture condition. A + sign in front of a percentage value indicates a gain in holding power; no sign indicates a loss in holding power.
[d] Shank types studied were common (C), cement-coated (Cc), box (B), ring (R), and galvanized (G).

values should not be interpreted to be significant. Keeping these facts in mind, little difficulty should be experienced in the proper interpretation of the tabular data on nail-holding properties.

Summary

Only factual data on a few of the more important strength and related properties of old-growth Douglas fir decayed by *Fomes pini* are given in this summary paper. Explanations and interpretations of these data are covered in detail in a more complete report.

The reductions in strength and related properties studied (Tables I and IV) suggest that the present stress grades of Douglas fir could be modified safely to include more of the class I and class II decay stages. The selection of appropriate nail types also would permit the use of large quantities of class III material for sheathing, roof boards, and subflooring in certain types of structures. The reduction in weight caused by the decay suggests the use of this wood as core material for special purpose plywood if satisfactory glue bonds can be obtained.

Discussion of Paper on Studies of the Strength of Glued Laminated Wood Contruction[1]

Mr. M. W. Jackson.[2]—An interesting paper on Studies of the Strength of Glued Laminated Wood Construction appeared in the December, 1950, ASTM Bulletin. It unfortunately gave the impression that glued laminated construction in this country dates from 1934 when the Forest Products Laboratory became interested in the subject or from 1936 when one member of the staff visited Europe to inspect foreign practice in that field.

Acknowledgment should be made to the actual pioneers in the field of glued laminated construction in the U.S.A. In 1919, John L. McKeown, of McKeown Bros. Co. of Chicago, which has been in the lumber business since 1894, began experimenting on bending timbers and binding them together with casein glue. In 1922 Mr. McKeown endeavored to obtain a patent on glued laminated structures, but was refused by the patent office on the grounds that using glue to hold pieces of wood together was not new.

In 1921, in the 16th edition of Sweet's Architectural Catalog, the McKeown Bowstring Trusses or wood arches with glued upper chords were advertised, the first known advertisement of glued laminated arches in this country. A portion of the 1921 advertisement is shown in Fig. 1. Among their early contracts was one on September 26, 1922, from the Chicago, Ottawa, and Peoria Railroad for five glued laminated wood roof trusses, and one on October 6, 1922, for similar trusses from the Chicago, Rock Island, & Pacific Railroad Co.

Mr. Kenneth C. McKeown recently wrote, "In the thirty years since 1921 that we have been selling glued chord trusses and arches, we have never had a failure or complaint in any of the thousands of jobs we have produced." He estimates that they have fabricated over 80,000 glued laminated bowstring trusses.

Among pioneer investigations of glued laminated wood arches was one at the University of Illinois conducted by Prof. W. A. Oliver in 1932. For this study four arches and two rigid frames with spans of 17 ft. 6 in. were fabricated by the Casein Manufacturing Co., Bainbridge, N. Y. This research study was financed partially by the National Committee on Wood Utilization of the Department of Commerce. One of the interesting conclusions from that study was that glued laminated wood arches behave in a manner similar to an ideal homogeneous arch of the same material as predicted by the elastic theory.

In 1931, tests of glued laminated rafters were conducted at Iowa State College by Henry Giese and E. D. Anderson. By the time the Forest Products Laboratory began its comprehensive research program on the strength and design features of glued laminated arches, there were several organizations fabricating and erecting successful structures of this type. The pioneers in this field in the U.S.A. deserve recognition and commendation.

Mr. A. D. Freas (*author's closure*).—Acknowledgment is made to Mr. Jackson for pointing out specific early uses of glued laminated members in structural applications and for mentioning some of the early research on the subject.

The author was fully informed of the developments and applications referred to by Mr. Jackson. In stating that "extensive development" in laminated construction did not begin until the middle or late 1930's, he was merely indicating the beginning of additional plant expansion and facilities that comprise the now very substantial laminating industry. Regardless of its exact beginnings, the important thing is that laminated construction has taken an important place in the building industry.

The art of joining wood with glue is, of course, centuries old and examples of glued structural members in the United States undoubtedly antedate even those mentioned by Mr. Jackson. For example, glued structural members such as aircraft parts were fabricated in this country as early as World War I.

[1] Alan D. Freas, "Studies of the Strength of Glued Laminated Wood Construction," ASTM Bulletin, No. 170, December, 1950, p. 48 (TP274).

[2] Assistant Professor of Civil Engineering, University of Colorado, Boulder, Colo.

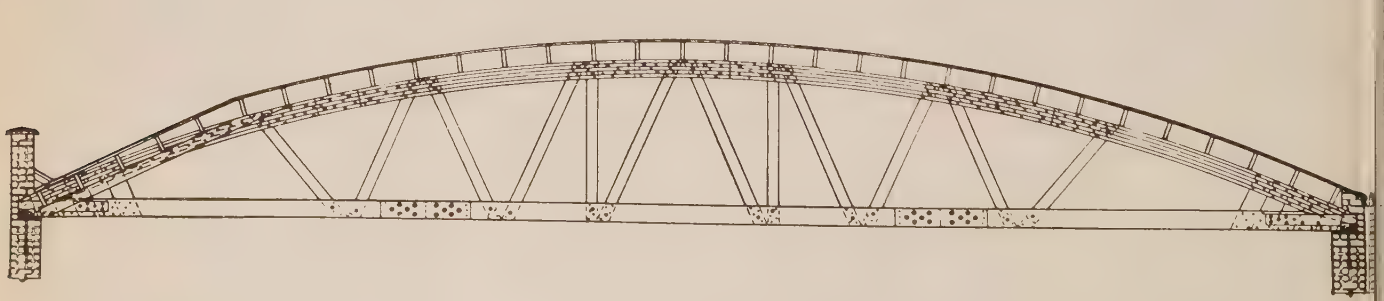

Fig. 1.—Bowstring Truss.

Built on the site of the job and erected by us, or shipped from Chicago knocked down, complete with nails and bolts and assembling directions. When trusses are shipped, laminated upper chord is glued with casein waterproof glue besides nailing, and retains its curvature under all weather conditions giving a section which is stronger than a solid timber. This truss when shipped knocked down can be assembled by any mechanic with a monkey wrench and hammer.

A Nomogram for Calculating the Stiffness of Elastomers

By T. B. Blevins[1] and M. G. DeFries[1]

A METHOD for determining the stiffness in flexure of elastomeric materials is outlined in the ASTM Method of Test for Stiffness in Flexure of Plastics (D 747–48 T).[2] The apparatus described therein is of the cantilever-beam bending type, and use of the Tour-Marshall and Olsen design is recommended. The test procedure involves bending a rectangularly shaped specimen by revolving the vise that holds one end of the specimen and allowing the free end to act upon a pendulum weighing system. Simultaneous readings are taken periodically of the angle of deflection, α, and the resultant load scale value, R. R is then plotted against α on Cartesian coordinates. The curve thus obtained is seldom a straight line, but it usually does have an initial straight portion. The ASTM method recommends that the slope of this initial straight portion be measured and used to calculate the stiffness in flexure by the formula

$$E = \frac{4S}{wd^3} \times \frac{M \times R}{100\phi}$$

where:

R = load scale reading (100 × in.),
E = stiffness in flexure, psi.,
S = span length, in.,
w = specimen width, in.,
d = specimen thickness, in.,
M = total of calibrated weights applied to the pendulum system, lb., and
ϕ = reading on angular deflection scale (α) converted to radians.

This formula can be simplified to

$$E = \frac{4S}{wd^3} \times 0.5730M \times \text{slope}$$

where 0.5730 is the conversion factor of degrees to radians.

Repeated experiments with elastomers have shown that the straight-line portion of the curve terminates near 20 deg. At higher angles of bend the slope usually increases rather rapidly. This is in agreement with the mathematical analysis of the test developed by Strechert,[3] which indicates that only about 3 per cent deviation from a straight line can be expected at 20 deg., whereas at 30 deg. the deviation approaches 10 per cent. He has developed a function N to replace ϕ which yields a more nearly uniform slope on bends up to 90 deg. An alternative approach to the reconciliation of the nonlinear character of the curve is to make the measurements at deflections less than 20 deg., where the deviations from a uniform slope are small. In order to attain precision using this procedure, S and M must be chosen in such a manner that $R \rightarrow 100$ as $\alpha \rightarrow 20$ deg.

$$\lim_{\alpha \to 20^\circ} R = 100$$

This is usually not difficult to achieve.

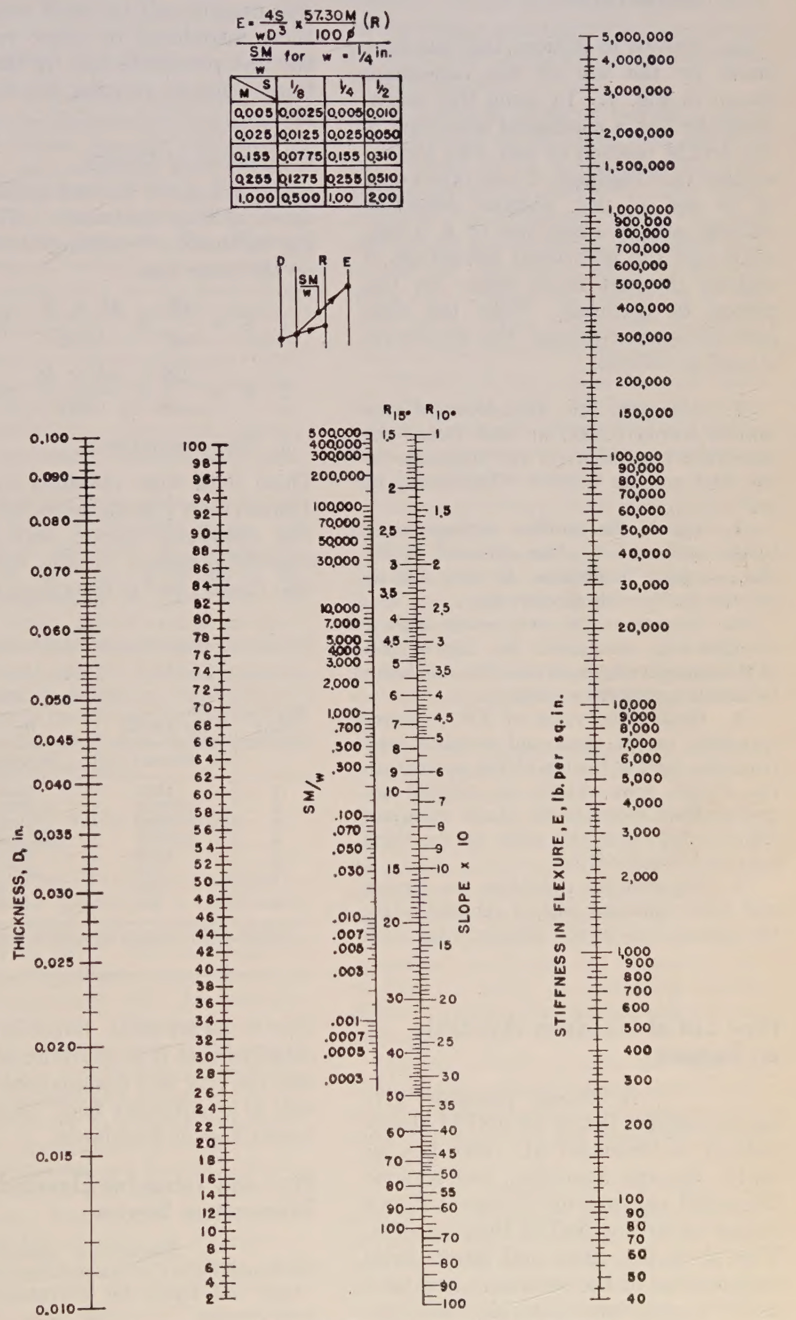

Fig. 1.—Nomogram for Tinius-Olsen Stiffness Tester.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Army Prosthetics Research Laboratory, Forest Glen, Md.

[2] 1949 Book of ASTM Standards, Part 6, p. 578.

[3] Dietrich G. Strechert, "Study of ASTM Tentative Stiffness Test as Applied to Rubber," ASTM BULLETIN No. 157, March, 1949, p. 61.

A mechanical difficulty attendant upon the above procedure is measuring the slope of the initial "straight-line portion," for the points seldom determine a perfectly straight line. A line can be fitted to the points by the method of least squares, but since this is a time-consuming procedure a line is usually fitted visually, which presents the possibility for errors to enter into the calculations.

From the foregoing discussion the following would appear to be desirable in calculating E:

1. Use R values taken at less than 20-deg. angular deflection.
2. Obtain the slope of R *versus* α without making a physical plot of the curve.

An attempt to achieve this has been made by the use of the nomogram shown in Fig. 1. In using this nomogram the test is conducted according to the ASTM method of test with the exception that readings, R, are taken only at 10 and 15 deg. angular deflection (taking only two readings of R 5 deg. apart has the additional advantage of making the test much easier for one person to perform). With the data from these two readings, the nomogram is used as follows:

1. Measure the thickness of the sample within 0.0005 in. and locate the numerical equivalent of the thickness on the first column labeled "Thickness, D, in."
2. Locate the number corresponding to the load scale reading obtained at 10-deg. angular deflection in the fourth column on the side labeled $R_{10°}$.
3. Connect these two points with a straight edge and mark the intersection of the straight edge and the second column (which is a reference column).
4. Obtain the value of SM/w corresponding to the span and weights used from the chart at the top of the nomogram (or if the span, width, or weights are greater than shown in the chart, calculate SM/w) and locate this value on the third column labeled SM/w.
5. Connect the points on the second and third columns with a straight edge; the intersection of the straight edge with the fifth column gives the value of E.
6. Record this value.
7. Repeat (1).
8. Repeat (2) with the exception that use is made of the value obtained at 15-deg. angular deflection, which is located on the side of the fourth column labeled $R_{15°}$.
9. Repeat (3) through (6).
10. If a marked difference is obtained in the two values of E, repeat the experiment.
11. Average the two values obtained for E. Two values of E are taken to detect any gross experimental error.

This method of calculation implies that the points at 10 and 15 deg. will lie on a straight line which passes through the origin. In actual practice this is seldom achieved, but the errors introduced due to the variations from this line usually will be small compared to those introduced by other variables in the test procedure and by the assumptions made in deriving the formula for E.

Comparison of Results:

Table I gives the test results from a series of four elastomers. The following methods of calculation were used on the same data:

1. $E = \dfrac{4S}{wd^3} \times \dfrac{M \times R}{100\phi}$ (ASTM)

2. $E = \dfrac{12S}{wd^3} \times \dfrac{M \times R}{100N}$ (Strechert)

3. The nomogram.

These data were obtained by using a Tinius-Olsen $\frac{1}{2}$ in.-lb. capacity machine. The elastomers tested were polyvinyl chloride plastisol, Silastic rubber, natural rubber, and polyacrylate rubber.

An important consideration in testing elastomers showing a rapid rate of stress relaxation is the speed at which the vise is driven. With a more rapid vise speed the stiffness values for these materials will be higher. To insure uniform speed of testing under all conditions the following procedures are suggested:

1. Operate the instrument from a constant voltage source.
2. Operate the motor at room temperature for 1 hr. and then determine the revolutions per minute of the crank handle.
3. Prior to performing each test with the instrument redetermine the revolutions per minute of the crank handle, with the instrument at the test temperature. If this differs by more than 1 rpm. from the value obtained at room temperature ascertain the cause of the discrepancy and correct it.
4. At subnormal temperatures lubricate all moving parts with silicone oils or kerosene.

Observing these precautions this laboratory has used this instrument at temperatures as low as −115 F. with completely satisfactory results.

Summary

A nomogram is presented that expedites the calculation of stiffness in flexure and that precludes the necessity of plotting a curve and measuring its slope. A series of measurements of stiffness was made on four elastomers, using a variety of thicknesses, spans, and applied weights, and the results were computed by ASTM, Strechert's, and the nomogram methods. The results from all three methods were in close agreement.

TABLE I.—STIFFNESS IN FLEXURE OF VARIOUS ELASTOMERS CALCULATED BY DIFFERENT METHODS.

Experiment Number	Stiffness in Flexure, psi.			Test Data		
	By ASTM D 747–48 T Method	By Strechert's Method	By Nomogram Method	Sample Thickness, d, in.	Span, S, in.	Bending Moment[a] (MR), in-lb.
1...	1300	2000	2000	0.088	0.5	1.000
2...	260000	308000	310000	0.0335	0.5	1.000
3...	5000	5750	5300	0.030	0.5	0.025
4...	210000	180000	195000	0.021	0.25	1.000
5...	8250	8650	8200	0.031	0.125	0.255
6...	975	1275	1150	0.031	0.125	0.080
7...	205	300	195	0.0555	0.125	0.025
8...	450	600	475	0.021	0.125	0.005

[a] Calibrated weights applied to the pendulum to give the indicated bending moment at full scale.

New List of Standards Available on Request

A 60-page pamphlet giving a complete list of all ASTM standards as of December 31, 1950, has recently become available, and anyone interested can procure a copy without charge by writing ASTM Headquarters. This gives the titles and latest serial designations of the standards arranged under appropriate materials headings. This is *not* an index, but is in sufficient detail so that it is not difficult to ascertain the title and designations of standards in a particular field. Ask for the Latest List of Standards.

Pipe and Tubes for Elevated Temperature Service

RECENTLY issued by the National Tube Co. is a publication entitled "Pipe and Tubes for Elevated Temperature Service."

The book is made up primarily of individual analyses of 25 different types of steel tubing, many of which conform to ASTM standards. Information on each type of tubing includes: Tensile Properties, Effect of Time and Temperature on Notch Impact Strength and Hardness, Applications, Hot Forming and Welding.

Those wishing copies should write, on company stationery, to National Tube Co., Tubing Specialties Div., Pittsburgh, Pa.

alendar of Other Society Events

"Long" and "short" calendars will appear in alternate BULLETINS. *The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.*

LECTROCHEMICAL SOCIETY—Spring Meeting, April 8–12, Wardman Park Hotel, Washington, D. C.

ANADIAN INSTITUTE MINING & METALLURGY—53rd Annual General Meeting, April 9–11, Quebec, Canada.

MERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Southern District, April 11–13, Miami Beach, Fla.

CIENTIFIC APPARATUS MAKERS ASSOCIATION—Annual Meeting, April 15–18, The Greenbrier, White Sulphur Springs, West Va.

MERICAN SOCIETY OF LUBRICATION ENGINEERS—National Convention, April 16–18, Bellevue-Stratford Hotel, Philadelphia, Pa.

MERICAN MANAGEMENT ASSOCATION, INC. —20th National Packaging Exposition, April 17–20, Atlantic City Auditorium, Atlantic City, N. J.

HE AMERICAN CERAMIC SOCIETY—53rd Annual Meeting, April 22–26, Palmer House, Chicago, Ill.

AMERICAN FOUNDRYMAN'S SOCIETY—55th Annual Convention, April 23–26, Buffalo, N. Y.

AMERICAN WOOD PRESERVERS' ASSOCIATION—Annual Meeting, April 24–26, Stevens Hotel, Chicago, Ill.

METAL POWDER ASSOCIATION—Annual Meeting, April 25–26, Hotel Cleveland, Cleveland, Ohio.

AMERICAN OIL CHEMISTS' SOCIETY—Spring Meeting, May 1–3, Roosevelt Hotel, New Orleans, La.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—North Eastern District, May 2–4, Syracuse, N. Y.

THE AMERICAN ASSOCIATION OF SPECTROGRAPHERS—Symposium on the "Use of Spectroscopy in the Steel Industry," May 4, Society of Western Engr. Bldg., Chicago, Ill.

5TH SOUTH AMERICAN CONGRESS OF CHEMISTRY, May 4–11, Lima, Peru.

FOREST PRODUCTS RESEARCH SOCIETY—Technical Sessions and Wood Products Exhibit, May 7–13, Convention Hall, Philadelphia, Pa.

AMERICAN INSTITUTE OF ARCHITECTS—Convention and National Seminar Meetings. Building Products Exhibit, May 8–11, Edgewater Beach Hotel, Chicago, Ill.

ENGINEERING INSTITUTE OF CANADA—Annual Meeting, May 9–11, Mount Royal Hotel, Montreal, Canada.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS—May 13–16, Hotel Muehlenbach, Kansas City, Mo.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Great Lakes District, May 17–19, Madison, Wis.

AMERICAN SOCIETY FOR QUALITY CONTROL—Annual Convention, May 23–24, Hotel Cleveland, Cleveland, Ohio.

SOCIETY OF THE PLASTICS INDUSTRY—Annual National Meeting, May 24–25, Greenbrier Hotel, White Sulphur Springs, West Va.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS—38th Spring Meeting, May 27–30, Hotel Statler, Detroit, Mich.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Semiannual Meeting, June 11–15, Hotel York, Toronto, Canada.

NATIONAL APPLIED MECHANICS CONGRESS—June 11–16, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS—June 13–16, Louisville, Ky.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS—Annual Meeting, June 14–16, Minneapolis, Minn.

American Society for Testing Materials—Annual Meeting, June 18–22, Atlantic City, N. J.

MALLEABLE FOUNDERS' SOCIETY—Annual Meeting, June 21–22, The Homestead, Hot Springs, Va.

AMERICAN SOCIETY FOR ENGINEERING EDUCATION—Annual Meeting, June 25–29, Michigan State College, East Lansing, Mich.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Summer General Meeting, June 25–29, Royal York Hotel, Toronto, Canada.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS—Semi-Annual Meeting, July 2–4, Portland, Oregon.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—Pacific General Meeting, August 20–23, Portland, Oregon.

ILLUMINATING ENGINEERING SOCIETY—August 27–30, Hotel Shoreham, Washington, D. C.

Trade Association Activities

THE Trade Association Department of the Chamber of Commerce of the United States recently published a classification and statistical survey of the activities and services of 509 trade associations entitled, "Association Activities." The publication tabulates 29 different activities engaged in by trade associations and shows results of a survey indicating, on both a numerical and percentage basis, the number of trade associations engaged in each activity. Standardization work ranked fifth, with more widely engaged-in activities listed as: governmental activities; advertising, promotion, public relations; statistics; employer-employee relations.

The standardization work engaged in by associations is on a voluntary basis. Of the 293 groups concerned with standardization about half had something to do with the preparation of some kind of standards, either safety codes, product specifications, testing work, or some facet of these. About half the associations indicated cooperation with other organizations in developing or promoting standards, and about one third cooperated with technical and engineering societies.

Conference on the Use of Radioactive Isotopes in Industry

THE Use of Radioisotopes in Industry is the subject of a conference scheduled at Iowa State College, Ames, from May 1–3, 1951. The conference is sponsored by the Engineering Extension Service in cooperation with the Institute for Atomic Research. The sessions are to be devoted to a consideration of the nature of radioactivity, availability of isotopes, equipment required, and design of laboratories. Reports are to be given of a number of actual applications to industrial research, development, and control. Ample opportunity will be available for questions and discussion. Background material will be presented by members of the staff of the Institute of Atomic Research and Ames Laboratory of the Atomic Energy Commission. One feature of the conference will be an exhibit of equipment used in monitoring and control. Further details are available from Dr. Glenn Murphy, 101 T. and A. M. Laboratory, Iowa State College, Ames, Iowa.

Word from N.P.A. on How Laboratories May Obtain Scarce Materials and Equipment

ASTM Headquarters has received from Mr. Louis Jordan, Executive Secretary, Division of Engineering and Research of the National Research Council, copies of letters recently exchanged between the chairman of the NRC and Mr. Glen Ireland, Deputy Administrator, National Production Authority. The letters concern assistance to university and scientific laboratories in obtaining materials and equipment in short supply.

Mr. Ireland's letter of February 14 to the chairman of the NRC is of particular interest since it outlines the procedure by which university and other scientific laboratories may request emergency assistance in obtaining materials and equipment in short supply. Since the information contained in the body of the letter will be of interest to many of our members, we reprint it:

"Thank you very much for your letter of January 30, 1951, bringing to our attention the matter of material and equipment shortages as they affect university and scientific laboratories.

"As you are aware, the National Defense effort has first call on the Nation's resources. Consequently, the present priorities rating system is confined to the use of those governmental agencies which have been delegated the authority to use such ratings by the National Production Authority. These ratings are assigned by the contracting officers who negotiate the contracts.

"However, material shortages as they relate to defense orders, as well as nonrated orders, are matters of current consideration by this Department. Present plans call for a revision of the current preference rating system. The new system of priority assistance will be similar to the controlled materials plan of World War II. This plan provides assistance to defense supporting and essential industries, including university and scientific laboratories. The new plan is scheduled to be in operation by July 1, 1951.

"In the interim period, the National Production Authority is prepared to consider specific requests for emergency assistance to university and scientific laboratories.

"Matters relating to the supply of scientific instruments and laboratory apparatus are the responsibility of the Technical Scientific Supplies Division of N.P.A. and it is suggested that you keep in touch with that Division concerning further developments."

PROFESSIONAL CARDS

On this page are announcements by leading organizations and individuals of their services.